

GREAT CLUSTER IN HERCULES

Photographed at Dominion Astrophysical Observatory, Victoria, British
Columbia, with the 72-inch reflector

EVENINGS WITH THE STARS

Evenings with the Stars

By MARY PROCTOR, F.R.A.S., F.R.Met.S.

Author of "Stories of Starland," "Giant Sun and His Family," "Legends of the Stars," the "Children's Book of the Heavens," etc ❀ ❀ ❀

Illustrated with 21 Charts, and 8 Plates from Photographs taken at the leading Observatories

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Dedicated
to the Memory of
MY FATHER

Who taught me how to
know and love the stars.

PREFACE

THIS book is specially written for those who have not made a study of astronomy, but who may wish to know something about the stars—when and where to look for them in the sky, the origin of their quaint names, and a few facts of interest concerning them from the observer's standpoint. Charts have been made in connexion with the groups of stars or constellations described, indicating their position with regard to each other during the course of the year. A few photographs taken with the most powerful telescopes have been added, with the kind permission of the Directors of the Yerkes, Mount Wilson, Lick, and Dominion (Astrophysical) Observatories, to give an idea of the revelations made by the camera as compared with the limited range of view obtained by means of an opera-glass or small telescope. The idea is to stimulate a desire to know more about a subject which so fascinated the great Herschel, who first adopted it merely as a hobby, as to lead to his becoming one of the greatest pioneers of this science the world has ever known.

MARY PROCTOR

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INTRODUCTION

MANY delightful evenings may be spent in observing the starry heavens, if, like Milton's hermit in *Il Penseroso*, we are able to—

Sit and rightly spell
Of every star that heaven doth show

First of all, it is necessary to become acquainted with the positions of the different constellations or groups of stars, knowing when and where to look for them. This becomes possible with the assistance of the many charts now provided for this purpose, so that if Carlyle were alive to-day he could no longer make his oft-quoted lament, "Why does not someone teach me the constellations, and make me at home in the starry heavens, which are always overhead and which I don't half know to this day?"

With the help of a good star chart, combined with patient persevering study, for ten minutes or so a week, one is soon enabled to recognize the leading brilliants of the firmament, such as Sirius, Arcturus, and other stars of the first magnitude. For this, no knowledge of astronomy is essential, any more than is a knowledge of botany requisite for the purpose of distinguishing a lily from a

Evenings with the Stars

rose. Moreover, just as there are seasons for the flowers of earth, so are there well-appointed seasons for the flowers of the sky. Thus, one soon becomes aware of the fact that it is as useless looking for the stars of Orion on a summer night, as searching for a rose (in northern climes) in December.

On the other hand, it is possible—as it were—to forestall the stellar seasons, by watching the stars from twilight until dawn, during which period of time, owing to the rotation of the earth, the stars seen early in the evening gradually wend their way westward, making room for new arrivals appearing on the eastern horizon. However, for one who is just starting on a ramble through Starland, an all-night watch is at first too overwhelming, and it is advisable to make the acquaintance of one or two of the brighter stars, and a constellation or so, at a time. These eventually become familiar landmarks in the sky, so that after a while we are able to enjoy watching the stars at leisure, untroubled by any further reference to charts. The pleasure one realizes in thus being able to read the stars at sight amply repays the observer for the difficulty experienced at first in tracing their positions in the sky.

There is undoubtedly a charm in learning the stars, quite apart from any use to which this knowledge may be applied. In connexion

Introduction

with the constellations and the quaintness of the outlines associated with them by people of olden times, the antiquity of these odd fancies, and the perception of the vast periods of time during which practically the same configurations have looked down upon the earth, lend an additional charm. Certain it is that a contemplation of the heavens on a calm, peaceful night, away from the glare and busy hum of the crowded streets of a city, must inspire in the least thoughtful a feeling of awe, approaching solemnity, when one considers the actual meaning of the celestial display. As Tennyson, the Poet of Science, expressed it :—

Yon myriad-worlded way—

The vast sun-clusters 'gathered blaze,
World-isles in lonely skies,

Whole heavens within themselves, amaze
Our brief humanities

In the clear skies of Arabia where the stars blaze forth in undimmed splendour, is it any wonder men were star-worshippers ? Concerning them, Carlyle wrote in his lecture on *The Hero as Divinity* —

To these primæval men, all things and everything they saw exist beside them, were an emblem of the God-like, of some God. And look what perennial fibre of truth was in that. To us, also, through every star, through every blade of grass, is not a God made visible, if we will open our minds and eyes ? We do not worship in that way now but is it not reckoned still a merit,

Evenings with the Stars

proof of what we call a "poetic nature," that we recognize how every object has a divine beauty in it, how every object still verily is "a window through which we may look into Infinitude itself" ?

To learn the stars is a task which may be made easy or difficult, according to the way the learner sets about its accomplishment. If in a haphazard way, at any convenient hour of the night, and with no special attention to the progress of the seasons, the intending learner turns his attention to the heavens and gets someone who knows the stars to tell him what this or that star is, or the name of some star group, he may be all his life studying the stars and still have to say with Carlyle (at 60), "I don't half know them to this day." But if, on the contrary, he observes the heavens once a week, or even once a fortnight, at the same hour for ten minutes on each occasion, and continues his observations systematically for a year, he will be able, in that time, to learn every constellation visible from his station, and (if he so desires) the names of all the conspicuous stars or even the Greek letter of every star that can be seen with the unaided eye.

Yet supposing him to make weekly observations he will have given in all but eight or nine hours during the year to the work, and they will not have been hours of hard work but of pleasant and instructive recreation. He will also

Introduction

have noted much about the planets in their journey among the stars, and have gained an insight into the movements (real and apparent) of the heavenly bodies, which could not have been so convincingly obtained from any amount of merely studying the outlines of a star chart, however clear. Five minutes or so of this in the daytime is sufficient preparation for the actual observation at night.

FIRST EVENING

THE GREAT BEAR AND THE LESSER BEAR

IN starting, no better course can be recommended than the old-fashioned one of tracing the outline of the seven bright stars known as "The Plough" or "Charles's Wain" in England,

and as "The Great Dipper"

in America

Everyone pre-

sumably knows

this group—if

not, the first

person he asks

can generally

point it out, and

it is of the ut-

most importance

that it should be

NORTHERN HORIZON

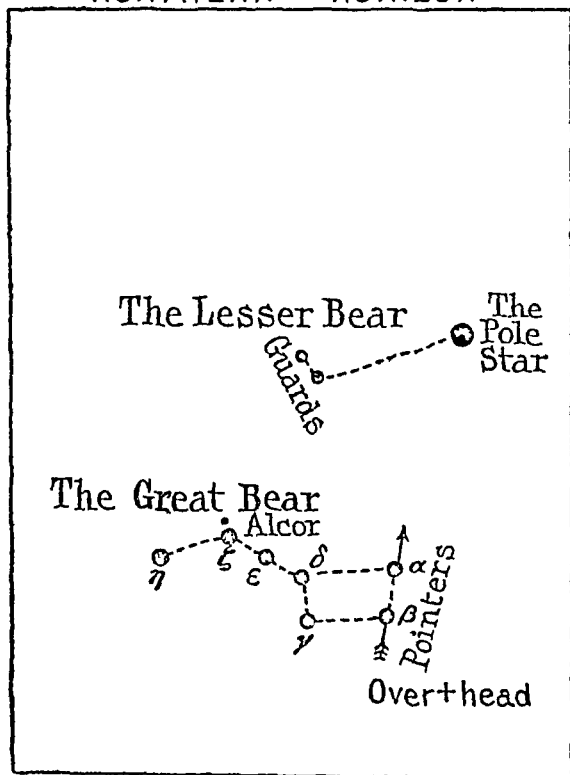


CHART I—THE GREAT BEAR AND POINTERS,
THE LESSER BEAR AND POLE-STAR

April 1, 9 15 p m	April 12, 8 30 p m
April 5, 9 0 p m	April 16, 8 15 p m
April 8, 8 45 p m	April 20, 8 0 p m

The Great Bear and the Lesser Bear

find the position of several groups in its neighbourhood, such as Bootes, Virgo, Auriga and others

The seven stars belong to the constellation of *Ursa Major*, the Great Bear, the outline of which is too indefinite to be helpful, but the seven stars of the Plough, of which they form part, have attracted attention through all ages. On star maps they are either denoted by Greek letters, or the names given to these stars by the Arabians of old.

α Alpha	} The Pointers	Dubhe	{	The Plough, or Charles's Wain, or The Great Dipper etc
β Beta		Merak		
γ Gamma		Phad		
δ Delta		Megrez		
ϵ Epsilon		Altoth and Alcor	{	The Three Horses and Alcor the Rider, or The Handle of the Great Dipper
ζ Zeta		Mizar		
η Eta		Benetnasch		

If we begin our study of the constellations in the springtime when the evenings are pleasant, as in the month of April, then on April 5 (as shown in Chart I) the seven stars of the Plough will be seen at nine o'clock to the left of the point overhead. The Pointers, Alpha and Beta, show the way to the Pole-star, Polaris, which is

Evenings with the Stars

between the point overhead and the northern horizon (The north *point* must not be confused with the north *pole* The north point is *on* the horizon, the north pole is high up in the sky, its height being equal to the latitude of the place from which the observation is being made) As Polaris is the first bright star directly in a line with the Pointers, there is no mistaking any star in its neighbourhood for this conspicuous and lonely one in that part of the sky

On a very clear night the group of stars called "The Lesser Bear" also shows seven stars, but they are so faint that usually the two known as the Guards, or the Guardians, are the only ones visible, and the Pole-star If possible, when learning the positions of the constellations, it is advisable at first to watch for them at the same hour and from the same place each evening Some local landmark should be found over which the Pole-star seems to hover It may be the steeple of a church, a tree, or the chimney of an adjacent house, but, whatever it is, it will help you to find the position of the Pole-star in the sky, at any hour on any night in the year (In "A Child's Story of a Star," Dickens dwells on this fact, making it the pivot around which the story revolves)

As a matter of fact, the Pole-star is not exactly at the pole of the heavens, but is the nearest conspicuous star to that point now. It is actually

The Great Bear and the Lesser Bear

about $1\frac{1}{4}^{\circ}$ (one and a quarter degrees) distant from it, revolving round the pole in a minute circle To give an idea of its size, there is a convenient scale of angular measurement in the distances separating the seven stars of the Plough From Alpha to Delta is 10° , from Alpha to Eta is 26° , and from Alpha to Beta (the "Pointers") is 5° , so that, small though that distance is, it exceeds that of the diameter of the minute circle in which the Pole-star apparently revolves

Nevertheless, the star seems motionless, and reference is made to this in Shakespeare's lines in *Julius Cæsar* (Act III, Scene 1) concerning the constancy of the northern star —

Of whose true-fix'd and resting quality
There is no fellow in the firmament

A glance at Chart II will give an idea of the changing position of the seven stars of the Plough, as seen at eight o'clock in the evening, at dates three months apart, during the course of the year To verify this statement, the observer who has the courage to watch the stars from twilight until dawn will find that the seven stars of the Plough will have swung backward (in a direction contrary to the hands of a watch) half-way round the Pole-star in that period It is because of this steady turning motion, or rotation round the pole of the heavens, that the stars of the Plough answer the purpose of a

Evenings with the Stars

clock in the sky from which one can gain a fairly good idea of the time Shakespeare refers to this, in the first part of *King Henry IV* (Act II, Scene I), when the first carrier says

An't be not four by the day, I'll be hanged, Charles' wain is over the new chimney

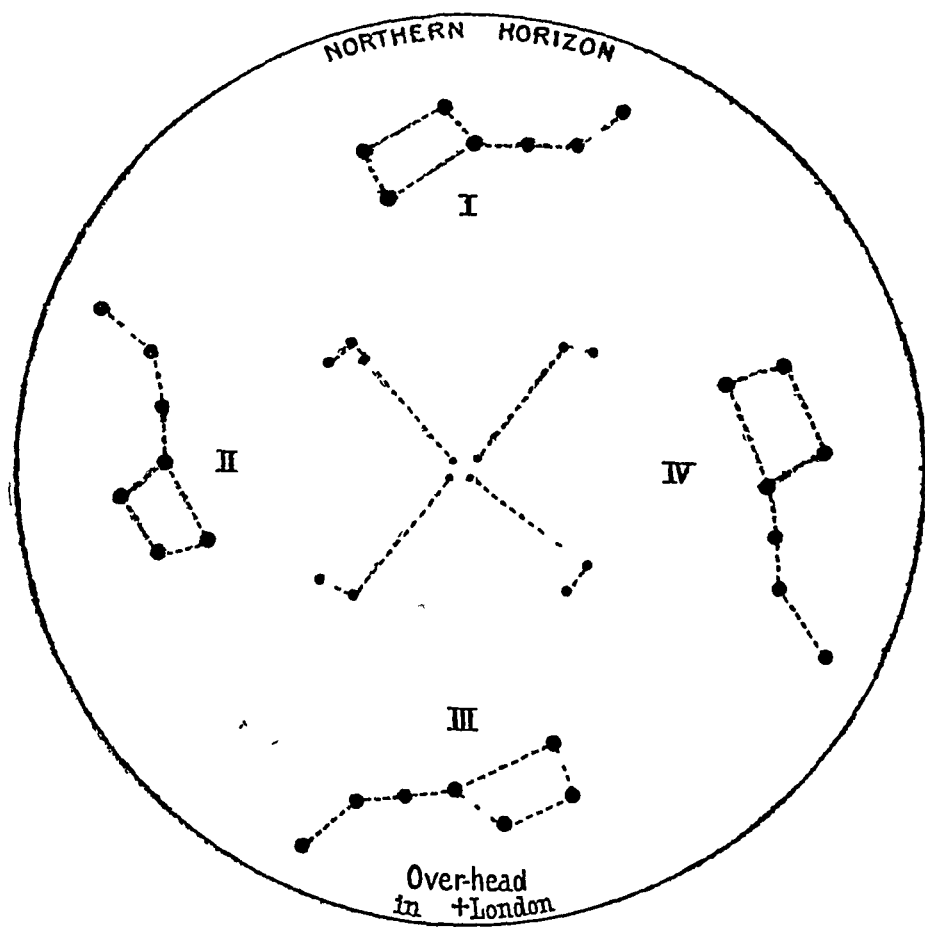


CHART II—CLOCK IN THE SKY, AS SHOWN BY THE STARS OF THE PLOUGH
Positions at 8 p m on I, November 22, II, February 19, III, May 21,
IV, August 23.

Legends about the Bears.—Let us suppose the beginner has learned to identify the seven stars,

The Great Bear and the Lesser Bear

the two stars known as "the Pointers" (the stars forming the back of the wagon), and the Pole-star to which they point, he may then wish to know something regarding the legends accounting for the names of the Great and Lesser Bears. How they came by these names is buried in the mists of antiquity, but we can imagine how shepherds who watched their flocks and herds by night associated with various star-groups the names of familiar objects animate or inanimate. Thus, we find the Ram, and the Kids, as names of certain sets of stars. Other groups would remind those early observers of the animals from which they had to guard their flocks, such as the Bear and the Lion, or of the animals such as the Dog to whose vigilance they trusted for protection. The figures of Bootes, the bear-driver, Hercules, the hero, and other Greek mythological deities, would naturally find a place in the starry outlines of the sky. Shepherds, hunters, and mariners would be apt to recognize the appearance of certain groups of stars coinciding with the progress of the seasons. As, for instance

When chilling winter spreads his azure skies,
Behold Orion's giant form arise

Virgil, Ovid, and Horace make mention of the rising of Orion, as accompanied with great rains and storms, so that it became a warning to mariners in their early adventures. Thus Æneas

Evenings with the Stars

accounts for the storm which cast him on the African coast while he was on his way to Italy

To that blest shore we steer'd our destined way,
When sudden, dire Orion rous'd the sea,
All charg'd with tempests rose the baleful star,
And on our navy pour'd his watery war

To induce Æneas to delay his departure,
Dido's sister advises her to—

Tell him, that, charg'd with deluges of rain,
Orion rages on the wintry main

The name of this constellation is mentioned in the Bible in the books of Job and Amos. The inspired prophet utters the sublime injunction “Seek Him that maketh the seven stars and Orion, and turneth the shadow of death into morning.”

In the Egyptian planispheres of remote antiquity the two constellations of *Ursa Major* (the Great Bear) and *Ursa Minor* (the Lesser Bear) are represented by the figures of bears. It is supposed the ancient Egyptians grouped these stars near the north pole, within the outlines of bears, because the polar regions are the haunts of this animal, and also because it makes neither extensive journeys nor rapid marches. These two groups are among the circumpolar constellations, which are always visible in the northern hemisphere at night throughout the whole year, never sinking below the horizon.

The Great Bear and the Lesser Bear

It is said by Aratus (the poet-astronomer), who lived about 270 B C, and was famous for his Weather-Forecasts by means of the stars), that the early Phœnician navigators made use of *Ursa Minor* in directing their voyages “Observing this, Phœnicians plough the main,” while the Greeks confined their observations to *Ursa Major*. At what period men began to sail by the stars, or who were the first people who did so, is not clear, but the honour is usually given to the Phœnicians. That it was practised by the Greeks as early as the Trojan war—that is, about 1200 years B C—we learn from Homer, for he says of Ulysses, when sailing on his raft, that—

Placed at the helm he sate, and mark'd the skies,
Nor closed in sleep his ever watchful eyes

It is natural to suppose that the stars were first used as guides by land, and, according to Diodorus Siculus, travellers in the sandy plains of Arabia directed their course by the “Bears.” That people travelled in these vast deserts at night by observing the stars, is directly proved by this passage of the Koran “God has given you the stars to be guides in the dark, both by land and sea.”

According to Grecian mythology, *Ursa Major* is said to be Calisto, or Helice, daughter of Lycaon, King of Arcadia. She was an attendant of Diana, and mother of Arcas, the hunter. In

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the days of long ago people thought that the earth was flat, and that the sky rested on the summit of Mount Olympus, whence Jupiter was supposed to hurl his thunderbolts' at the wrong-doer, and give the righteous a place among the stars. He was approached on one occasion by his beautiful wife Juno, whose jealousy had been aroused by the suggestion made by Calisto that her beauty surpassed her own. In her wrath Juno appealed to Jupiter, who, fearing she might harm Calisto, changed the vain boaster into a bear. Calisto's son, Arcas the hunter, one day, when in pursuit of the chase, saw the bear and was about to kill it, when Jupiter, moved to compassion at the pitiful sight, changed him into the little bear, and placed the two bears near each other in the sky. Thus, in his translation of Ovid's *Metamorphoses*, Addison writes that Jove—

. snatched them through the air,
In whirlwinds up to heaven and fix'd them there,
Where the new constellations nightly rise,
And add a lustre to the northern skies

Juno, it is said, indignant at the honour thus shown to Calisto and Arcas her son, persuaded Tethys and Oceanus to forbid the Bears to descend into the sea. (In Chart II it is shown that the Great and Lesser Bears are always circling between the point overhead and the northern horizon.)

The Great Bear and the Lesser Bear

Lowell in *Prometheus* thus refers to the foregoing legend

One after one the stars have risen and set,
Sparkling upon the hoar frost of my chain
The Bear that prowled all night about the fold
Of the North Star hath shrunk into his den,
Scared by the blithesome footsteps of the dawn

According to another legend, this constellation represented a princess, transformed into a bear on account of her pride in rejecting all suitors. For this, her skin was nailed to the sky as a warning to all proud maidens. A modern Grecian legend relates that originally the sky was said to be made of thin glass, which touched the earth. Upon this was nailed the skin of a bear.

The following unique reason for the length of the Great Bear's tail is to be found in the "Memoir of Augustus de Morgan" (page 67), concerning a book on astronomy written in 1590

Scholar I marvel why (seeing she hath the form of a beare) her tayle should be so long

Master I imagine that Jupiter, fearing to come too nigh unto her teeth, layde holde on her tayle, and thereby drewe her up into heaven so that shee of herself being very weightie, and the distance from the earth to the heavens very great, there was great likelihood that her tayle must stretch. Other reason know I none

An elementary star atlas such as my father's "Half Hours with the Stars," which contains a

Evenings with the Stars

map of the stars for each month of the year, will enable the student of the constellations to trace the positions of *Ursa Major* (the Great Bear) and *Ursa Minor* (the Lesser Bear) during the course of the year. Returning each week or fortnight to the ten minutes or so of watching the stars, the observer will soon find that he is able to recognize these two groups at a glance.

It must always be kept in mind, however, that all the stars round the Pole are carried round once in every twenty-four hours in a direction contrary to that in which the hands of a clock revolve. If the same hour is selected each evening for observation, it will be obvious that they are carried completely round the Pole-star once in a year, as shown by Chart II, a circuit during the course of 365 days corresponding to about four minutes' gain per day. To prove this, a chart made each evening by the observer, noting the position of the seven stars, as compared with the landmark used for locating the Pole-star, at the same hour each night, will be of interest.

Revelations of an Opera-glass.—By means of an opera-glass faint stars can be seen which are not visible to the unaided eye. With the assistance of such a book as "Astronomy with an Opera-Glass," by Garrett P. Serviss, much additional pleasure may be obtained in observing the stars. The star Mizar, for instance



THE OWL NEBULA IN THE GREAT BEAR,
FEBRUARY 9 1910

Photographed at Mount Wilson Observatory



NEBULÆ IN THE PLEIADES,
DECEMBER 8, 1888

Photographed at Crowborough Observatory by Dr Isaac
Roberts

The Great Bear and the Lesser Bear

(Zeta, the middle horse), is seen to be widely separated from Alcor, the small star denoting the Rider (See Chart I) If you are the fortunate owner of a two-inch telescope you will find that Mizar itself is a double star, one being white, the other pale green Another fainter star also becomes visible, so that, with Alcor, four stars are to be seen in the field of view of the telescope

Turn the opera-glass to the whole length of the Plough, and many stars are revealed, while a telescope would show the region literally powdered with stars Near the second "Pointer" is a spot of faint light, which Sir John Herschel described as "a most extraordinary object," and to which the name of the "Owl Nebula" has been given from the appearance it presents of two great eyes staring from out the darkness of space

Each of the seven stars representing the group known as the Plough is a mighty sun, probably far exceeding our own Day-star, the Sun, in size, splendour, and magnificence Like the Sun, each one of the seven stars (which applies to all the stars we see in the heavens on a clear night) is a mighty crucible, wherein such stubborn metals as steel and iron are reduced to glowing vapour. "The air of every star is a mixture of iron-steam, zinc-steam, calcium-steam, and many other such fiery vapours, besides hydrogen,

Evenings with the Stars

and all these vapours are so hot that they shine with their own inherent lustre. Imagine an atmosphere such as this, where the clouds which form are metallic drops, and the rains which fall are sheets of molten metal."

Moreover, these stars are urging their way through space at the rate of seventeen miles in every second of time. There seems, however, to be discord in the family party of seven, for while five of the stars are drifting in one direction, two are drifting in the opposite, with the result that one hundred thousand years hence the outline of the group will no longer be recognizable as compared with the one familiar to us now. This surprising discovery, which my father termed "star-drift," was made by him in 1868, and has since been abundantly confirmed by means of the spectroscope. (He refers to this in his book entitled "The Universe of Stars," second edition, pages 118-122.)

SECOND EVENING

DRACO, THE DRAGON

the vast Dragon twines
Between the Bears and like a river winds
—*Virgil*

AFTER learning exactly when and where to look for the two Bears in the sky during the month of April, it is time to add to our knowledge by directing attention to the constellation of the Dragon, which “winds its sinuous way” in and out between the Bears, round the Guardians of the Pole (see Chart III), round the Pole itself in a wide sweep, and presently bends back towards two bright stars (not unlike the Guardians for brightness and distance apart) which mark the Dragon’s eyes. To these, Aratus, the poet-astronomer refers as—

Eyes oblique retorted
Which aslant cast gleaming fire

The Dragon adds a wide region of sky to the observer’s view, and one must become thoroughly acquainted with the stars marking its outline, as well as those of the Great and Lesser Bears before venturing further afield in search of new

Evenings with the Stars

groups in stellar realms A few moments of observation on any clear night in April is bound

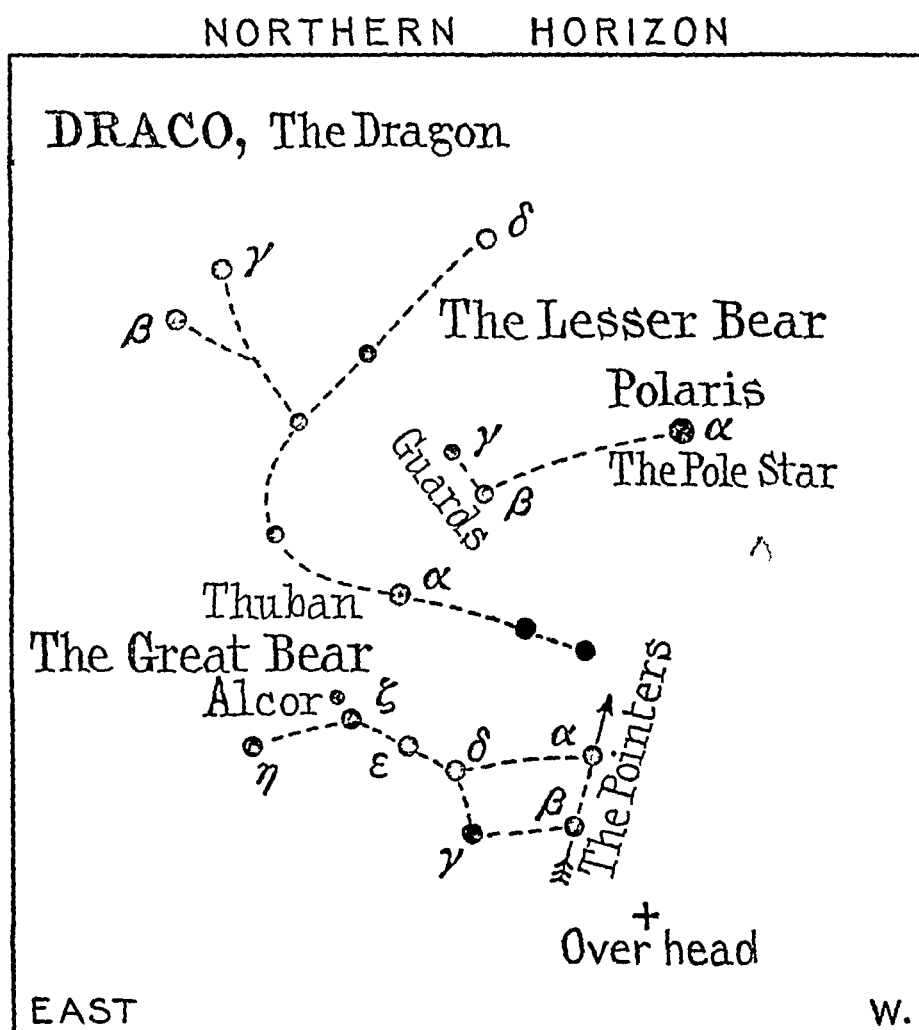


CHART III—THE GREAT BEAR, LESSER BEAR, AND THE DRAGON

April 1, 9 15 p m

April 12, 8 30 p m

April 5, 9 0 p m

April 16, 8 15 p m

April 8, 8 45 p m

April 20 8 0 p m

to fix the position of the Bears and the Dragon indelibly in the mind, so that, whenever they are seen, they are instantly recognized as our new friends in Starland.

Draco, the Dragon

Legends about Draco, the Dragon.—By some mythologists this serpent is supposed to be the

NORTHERN HORIZON

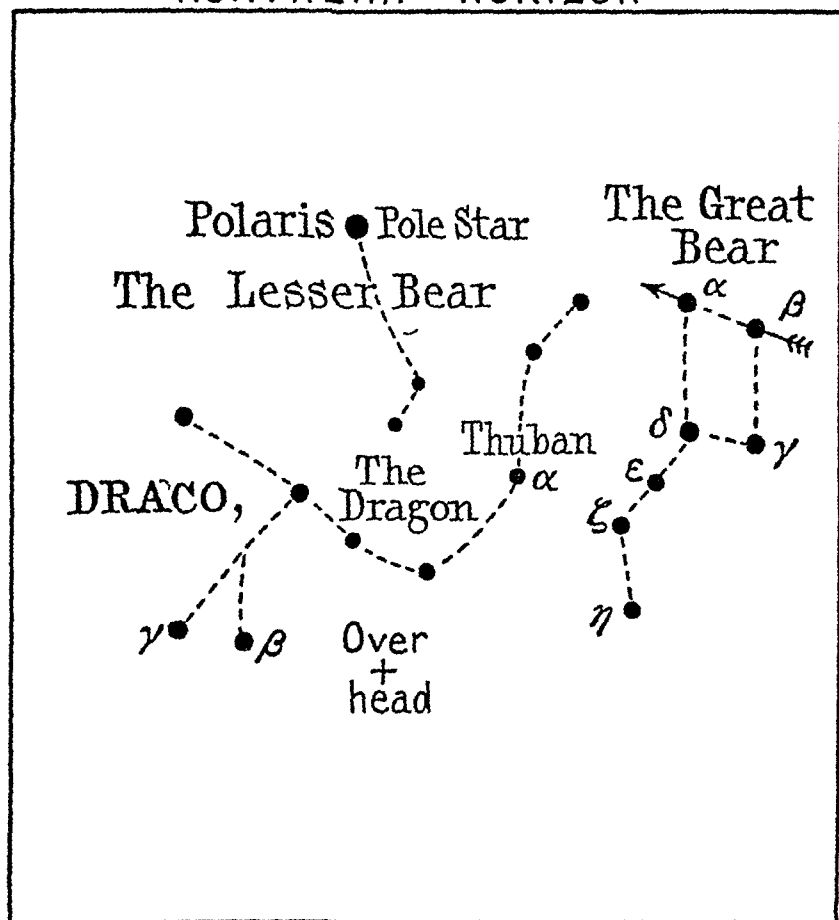


CHART IV.—THE GREAT BEAR, LESSER BEAR, AND THE DRAGON

These constellations circle around the Pole star, and are to be found (in northern latitudes) between the northern horizon and the point overhead. The relative positions are here shown in the month of July.

guardian of the stars (the golden apples) which were said to hang from the Pole-tree in the Garden of Darkness—that is, the Garden of Hesperides near Mount Atlas in Africa. Others claim that

Evenings with the Stars

it was the snake snatched by Minerva from the giants and whirled to the sky before it had a chance to uncoil. Thus twisted, it has remained coiled around the pole of the heavens ever since.

The constellation of the Dragon never sets in northern latitudes, for which reason the Greeks saw in it an emblem of eternal vigilance, guarding the precious fruit in the Garden of Hesperides. Juno, it is said, presented these golden apples to Jupiter on the day of their nuptials, and rewarded the dragon—which had been slain by Hercules—for services rendered by placing it among the stars. In old maps Hercules is represented with his foot on the head of the Dragon, which, as will be shown later on, makes it easy to locate the stars of Hercules.

The prominence of Draco as the very crown of the celestial sphere may be due to the fact that when astronomy was first cultivated in Chaldea Draco was the polar constellation. This was in the year 2790 B C, when the star Thuban, or Alpha Draconis, was the Pole-star. A passage in the Great Pyramid was built in such a way that the light of this star shone down it in the year 2170 B C*. Thuban was much closer to

* "This passage, 4 feet by $3\frac{1}{2}$ feet diameter and 380 feet long, was directed northward to this star, doubtless by design of the builders, from a point deep below the present base, at an inclination of $26^{\circ} 17'$ to the horizon. At the time of its building, perhaps four millenniums before our era, the Southern Cross was entirely visible to the savage Britons." See "Star Names and Their Meanings," p 207 R H Allen

Draco, the Dragon

the true pole of the heavens than Polaris is at the present time, and for that reason must have seemed an absolutely fixed centre round which all the other stars revolved.

The star Gamma, which marks one of the eyes of the Dragon, was called "Eltanin"—the Dragon's Head—by the Arabs. It vies with Thuban in interest, and in early Egypt was worshipped as Isis. The central passages of the temples of Hathor at Denderah, and that of Thut at Thebes, were oriented to it, the former about 3500 B.C. Long afterwards it served for the orientation of the great temple at Karnak, according to Sir Norman Lockyer. He was also of the opinion that the goddesses Apet, Mut, Taurt, and Sekhet were the same goddesses under different names, and symbolized Gamma Draconis.

Eltanin (Gamma Draconis) lies almost exactly in the zenith of Greenwich, and hence it has been called the "zenith star", but its chief interest is connected with the observations made by Dr Bradley in 1725, which led to the discovery of the laws of the aberration of light. The principle is simply as follows—One who walks along briskly when the rain is coming straight down does not hold his umbrella straight up, but slants it forward. The analogy of the umbrella as held in a downpour of rain is one we can easily verify for ourselves.

Supposing, however, that for observational

Evenings with the Stairs

purposes we are anxious to make an experiment which necessitates standing in the rain without the protection of an umbrella overhead, we shall obtain a better idea of the problem that Bradley tried to solve. Hold a hollow tube straight up, and if we watch the raindrops they will be seen to pass through the tube without touching the sides, but should we walk briskly forward still holding the tube upright, the drops of rain entering at the top of the tube will be seen to splash against the side. However, by slanting the tube forward at the proper angle the raindrops will pass through freely.

Now let us see how this applies to the passage of the rays of light from a star, down to the Earth, passing through the tube of a telescope to the observer's eye. If the Earth were motionless and an astronomer pointed a telescope so that it faced a fixed star, the rays of light from the star would come down through the telescope tube and emerge at the eyepiece. But the Earth is moving at the rate of about nineteen miles a second, so that it becomes necessary to slant the telescope by a minute angle. The rays of starlight, after passing through the object-glass, then emerge at the centre of the eyepiece. Now the star seems to lie in the direction in which the telescope points, but its ray appears to have a slanting direction! This was the problem which puzzled Dr Bradley, and it was two or

Draco, the Dragon

three years before the real explanation occurred to him

It was most important that he should have a long telescope which should command a wide field of view, and fortunately for him an obliging aunt allowed him to cut holes in the floor and roof of her house so that his wish might be attained. The object-glass end of the improvised telescope was out on the roof and the eye-end down in the coal-cellar, and it was here that Bradley made the observations which led to his immortal discovery

However, he found the real solution of the problem almost accidentally. In his own words "At last, when I despaired of being able to account for the phenomena which I had observed, a satisfactory explanation of them occurred to me all at once when I was not in search of it." He had accompanied a pleasure party in a sail upon the Thames. The boat in which they were was provided with a mast, which had a vane at the top of it. It blew a moderate wind, and the party sailed up and down the river, but Dr Bradley remarked that every time the boat put about the vane at the top of the boat's mast shifted a little, as if there had been a slight change in the direction of the wind.

After observing this three or four times, he asked the boatmen why it was that the wind seemed to shift so regularly every time they

Evenings with the Stars

put about. They told him that the wind had not shifted, but that the apparent change was due to the actual change in the direction of the boat, and assured him that the same thing invariably happened in all cases. This accidental observation led him to conclude that the phenomenon which had puzzled him so much was owing to the combined motion of light and of the Earth.

To return to the analogy of the umbrella. The rays of starlight may be compared to the drops of falling rain, and our planet Earth, moving at the rate of nineteen miles a second, to the traveller hurrying briskly on his way. Like most problems, that of the aberration of light seemed very simple when the answer was obtained, but it meant two or three years of hard observational work on the part of Dr. Bradley.

In looking at the star Eltanin (Gamma Draconis) one forms a mental picture of the astronomer at work in the coal-cellar—his aunt with her knitting, in the room above, cheerfully enduring the cold blasts which must at times have blown through the hole in the ceiling, and Eltanin beaming down on Dr. Bradley while he was attempting to discover why its ray of light was shifted. It is true that there were seventy other stars under observation, but Eltanin was undoubtedly the most important of them all, therefore the leader.

Draco, the Dragon

Continuing his observations on aberration, Dr Bradley found that the theory did not entirely account for apparent changes taking place in the positions of these stars. A second cause seemed to be at work, a wobbly movement of the Earth's axis in its inclination, which is technically called nutation. It is a slightly swaying movement of the axis of the Earth, due to the unequal attraction of the sun and moon, causing the pole to describe a small wavy ellipse. This was discovered by Dr Bradley in 1748.

On the death of Halley, in 1742, Dr Bradley was appointed to succeed him as Astronomer Royal, and he distinguished himself by the high standard to which he raised the practical work of observation. His last work was the preparation for the observations of the transit of Venus, of 1761, according to the lines laid down by his predecessor Halley, but the actual observations were made by the Rev. Nathaniel Bliss (his successor as Astronomer Royal), as his health broke down and he died the following year, at the age of 70. An inscription on a brass plate in the south transept of the Parish Church at Minchinhampton, Gloucestershire, testifies to his modesty regarding his own attainments, for "he alone seemed ignorant of the high reputation in which he was held by those most competent to judge"

THIRD EVENING

BOOTES, THE BEAR-DRIVER, CORONA BOREALIS,
THE NORTHERN CROWN; AND COMA BERENICES,
THE HAIR OF BERENICE

AFTER locating the Bears, and the Dragon, let us turn our attention to the constellation of Bootes, the Bear-Driver —

. whose ordered beams
Present a figure driving on his teams
Below his girdle near his knee he bears
The bright Arcturus, fairest of the stars

The Bear-Driver is shown on old star maps as a huntsman in a running posture, holding in his left hand the leash of his two greyhounds Asterion and Chara, with which he seems to be pursuing the Great Bear round the pole of the heavens. Opinion seems to be divided as to whether this group of stars is supposed to represent Arcas, the hunter, who was said to be transformed into the Little Bear, or Icarus, the father of Erigone (Virgo), a constellation to the south of Bootes.

The best time to trace the outline of Bootes is during the latter part of April, or early in May, when, as shown in Chart V, the stars of

Bootes, the Bear-Driver

the Plough are directly overhead at a convenient hour in the evening They form an excellent

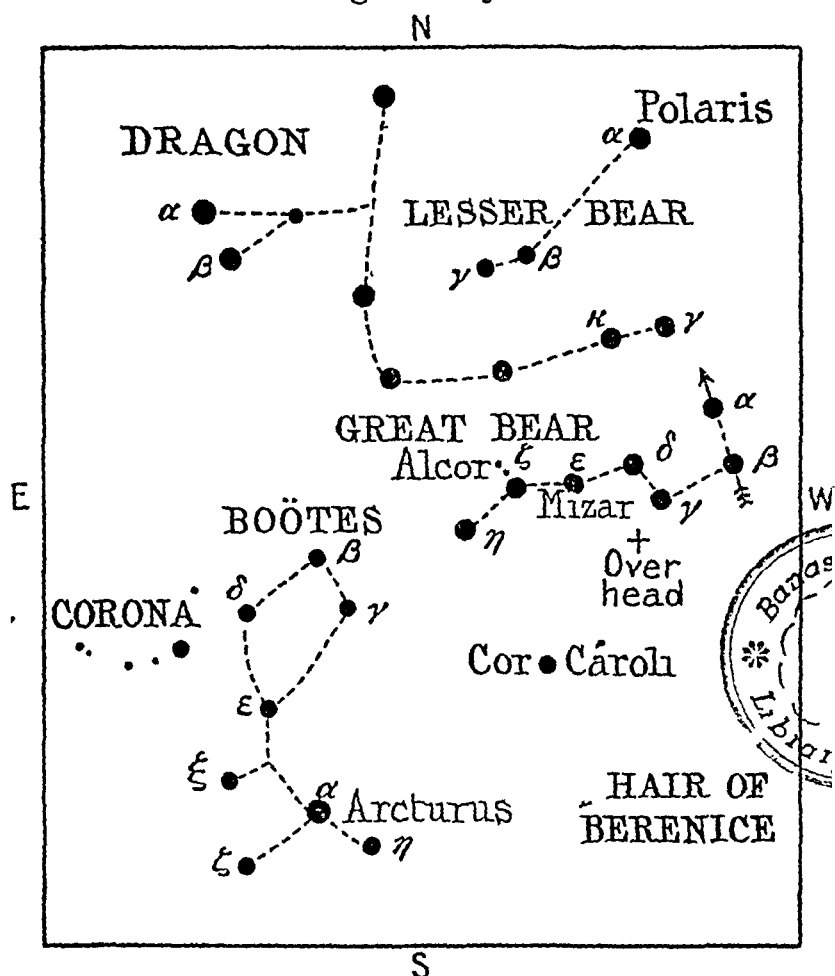


CHART V—THE DRAGON, GREAT BEAR, LESSER BEAR, BOÖTES, CORONA,
HAIR OF BERENICE, COR CAROLI

April 20, 10 0 p m	May 1, 9 15 p m
April 23, 9 45 p m	May 5, 9 0 p m
April 27, 9 30 p m	May 9, 8 15 p m

guide, for by following the curve of the three stars (the three horses) the first bright star we come to is Arcturus, the brightest gem of the heavens during the spring and summer months

Evenings with the Stars

of the year This is evident from the fact that if we begin to watch for the stars in the early twilight, before it deepens into the shades of night, Arcturus is the first star that comes into view This may account for the name given to it by the dwellers on the banks of the Euphrates, who called it the "Shepherd of the Heavenly Flock", or its Arabic title of the "Keeper of Heaven," which may have been suggested because, as it is the first star seen in the twilight, it seemed to be the advance guard on watch for the safety of its lesser companions. Thus it was the "Patriarch Mentor of the Train."

There is no mistaking this star for any other, and still further to ensure its recognition a glance at Chart V will show that the outline of the constellation Bootes is uncommonly like that of a boy's kite. Arcturus is the star in the tail of the kite, and there are two smaller stars at the left of the tail, to steady it, as it were, and keep it from blowing away into space. Nevertheless, Arcturus is well known as "the Run-away Star," since it is hurrying along at a rate of more than two hundred miles per second—possibly three hundred miles. One might expect that so brilliant a star must be comparatively near to us, but although it is approaching the Earth at an average speed of somewhere about 40 miles a second, yet we have been able only roughly to estimate its distance.

Bootes, the Bear-Driver

A ray of light, which travels at a speed sufficient to carry it seven times round the Earth in a second, would require about 30 years in crossing the vast abyss separating us from Arcturus.

Once the position of this wondrous star in connexion with the neighbouring constellations becomes indelibly impressed on our memory, we realize with pleasure that another friend in Starland has been added to our list which includes the Bears and the Dragon. In writing about Arcturus, in "Astronomy with an Opera-Glass," the author remarks that this star possessed a peculiar charm for him ever since boyhood, when "having read a description of it in an old treatise of Uranography, I felt an eager desire to see it. As my search for it chanced to begin at a season when Arcturus did not rise till after a boy's bedtime, I was for a long time disappointed, and I shall never forget the start of surprise and almost of awe with which I finally caught sight of it, one spring evening, shooting its flaming rays through the boughs of an apple-orchard, like a star on fire."*

Objects of Interest.—Seen with an opera-glass, Arcturus appears to glow with a ruddy hue when it is low down near the horizon, but as it approaches mid-heavens the colour changes to a golden-yellow tint. If a powerful field-glass is turned in its direction this stellar king

* "Astronomy with an Opera-Glass," p 54 G P Serviss

Evenings with the Stars

is found to be escorted by a veritable cluster of stars, accompanying him on his journey along the highways of Starland.

Lying 10° (the distance from Alpha to Delta in the Plough) north-east of Arcturus is the double star Epsilon, better known as Mirac. It was called Pulcherrima, or Very Beautiful, by the astronomer Struve, on account of its beauty. The larger star is orange, and the smaller one pale green, but a telescope is required to show them. They can be seen with one having a $2\frac{1}{4}$ -inch aperture.

There are many other double stars in this region of the sky, but they are out of reach of the limited power of an opera-glass, yet it is well worth while making an attempt to see them with the aid of a telescope, if one can be obtained for the purpose.

CORONA BOREALIS, THE NORTHERN CROWN

This beautiful little constellation lies 20° (twice the distance from Alpha to Delta in the Plough) north-east of Arcturus, and is at once detected as an almost perfect semicircle composed of half a dozen stars, among which the brightest, Alphecca, is easily detected with the naked eye. (On Chart V the outline of the semicircle is given *as seen with an opera-glass*, for usually only Alphecca, a star of the second magnitude, can

Corona Borealis, the Northern Crown

be seen without its assistance, unless the observer has keen eyesight)

The constellation is said to be the crown given by Bacchus to Ariadne, the daughter of Minos, the second King of Crete, after she had been deserted by Theseus. According to the Grecian legend, Theseus, King of Athens (125 B C), was shut up in the celebrated labyrinth of Crete to be the victim sacrificed to the ferocious Minotaur, but he slew the monster and succeeded in escaping from the labyrinth by means of a clue of thread furnished by Ariadne. Afterwards he married her, according to his promise, and went with her to the island of Naxos, but later on he basely deserted her. Ariadne was so disconsolate that—as some writers say—she hanged herself, but the historian Plutarch gives a more cheerful ending to the legend. According to his story, she lived many years after and was espoused to Bacchus, who gave her a crown of seven stars. After her death this crown, known as the constellation Corona Borealis, was placed in the sky. According to Manilius

Near to Bootes the bright crown is viewed
And shines with stars of different magnitude,
One placed in front among the rest displays
A vigorous light, and darts surprising rays
This shone, since Theseus first his faith betrayed,
The monument of the forsaken maid

Another writer, named Apollonius Rhodius,

Evenings with the Stars

wrote of it, as early as the 3rd century B C as follows —

Still her sign is seen in heaven,
And 'midst the glittering symbols of the sky
The starry diadem of Ariadne glides

Alphecca—the star Manilius describes as darting “surprising rays”—is represented in early drawings of the constellation Corona Borealis as occupying the central position on a knot of ribbon along which are fastened flowers and leaves. For this reason it has sometimes been referred to as the “Wreath of Flowers.”

From the 12th of April to the 20th of June meteors may occasionally be seen gliding earthward from a point near Alphecca. They are known as the Coronids, since they radiate from the region in the sky in which the constellation of Corona is to be seen. Dante thus describes these meteors —

As oft along the still and pure serene
At nightfall, glides a sudden trail of fire,
Attracting with involuntary heed
The eye to follow it, erstwhile it rests
And seems some star that shifted place in heaven

There is no connexion between meteors and the new star known as the “Blaze Star,” which suddenly blazed forth within a few degrees south of Epsilon (Mirac). This occurred on May 12th, 1866, and the star—called Coronæ—for a time equalled Alphecca in magnitude. Then it grad-

Coma Berenices, the Hair of Berenice

usually faded in brightness, and an opera-glass shows it as a star of the ninth magnitude—referring to brightness, not size. It is too faint to be seen with the unaided eye,

like those faint stars that come in sight
Once in a century (LOWELL)

COMA BERENICES, THE HAIR OF BERENICE

As a companion to the Crown of Ariadne we find to the right of Bootes (Corona being to the left) the streaming tresses of Queen Berenice. How they found their way to this remote region of the sky is explained by the following quaint legend told by the Greeks —

Berenice, who was of royal descent, was the wife of Ptolemy Soter—or Evergetes, a king of Egypt. On one occasion, when he was starting on a dangerous expedition against the Assyrians, Berenice was much alarmed, fearing for his safety. She went to the Temple of Venus, the Goddess of Love, promising to cut off her hair and give it to the gods if her husband returned victorious from the fray.

Hearing that he had succeeded in defeating the enemy, she kept her promise, and cutting off her hair hastened with it to the temple. When her husband returned he was not only surprised but distressed at the appearance of his wife with bobbed hair, although he deeply appreciated the motive which had prompted her to

Evenings with the Stars

make this generous sacrifice on his behalf. Next morning, however, his anger was justly aroused when he heard that the "streaming locks" had mysteriously vanished from the place where they had been placed by Berenice.

The wise man Conon was summoned to explain how this had happened, and he announced that Jupiter had taken the locks from the temple and placed them eternally among the stars.

There Berenice's locks first rose so bright,
The heavens bespangling with dishevelled light.

This group of stars being among the unformed constellations at that time, and therefore unknown to the king, the latter was satisfied with the explanation, and the queen herself was flattered at this token of approval shown by the gods

Immortal Conon, blest with skill divine,
Amid the sacred stars behold me shine
E'en me, the beauteous hair, that lately shed
Refulgent beams from Berenice's head
The locks she fondly vowed with lifted arm,
Imploring all the powers to save from harm
Her dearer lord, when from his bride he flew,
To wreak stern vengeance on the Assyrian crew

(Translation from "Callimachus" by Tyler.)

Objects of Interest.—The stars in this cluster are so closely grouped together that they somewhat resemble the hazy cloudlike appearance of the stars in the Milky Way. The group

Coma Berenices, the Hair of Berenice

crosses the meridian on the 13th of May, when it can be seen at its best. Turn an opera-glass in the direction of this cluster, and it resolves itself into a gossamer web bespangled with bright stars, the "beautéous hair" of Berenice literally interwoven with the glittering jewels of the sky. A field-glass increases the number which can be seen, while a small telescope enables one to see some of the smaller stars which adorn her "streaming locks."

FOURTH EVENING

VIRGO, THE VIRGIN, HYDRA, THE WATER-SNAKE;
CORVUS, THE CROW, AND CRATER, THE CUP

Below the Waggoner's feet

Lo! the Virgin, in her hand a glittering ear of corn

The Skies ARATUS

THE above quotation is an excellent guide to the position of the group of stars known as Virgo, the

Virgin, one of the twelve signs of the Zodiac, within whose boundary the planets Mars, Jupiter, Saturn, etc., wend their way. By following the curve of the three stars in the Plough downward through Arcturus, and about the same distance therefrom, we find the bright star Spica, the leading brilliant in Virgo. A glance at Chart VI shows the position of this star.

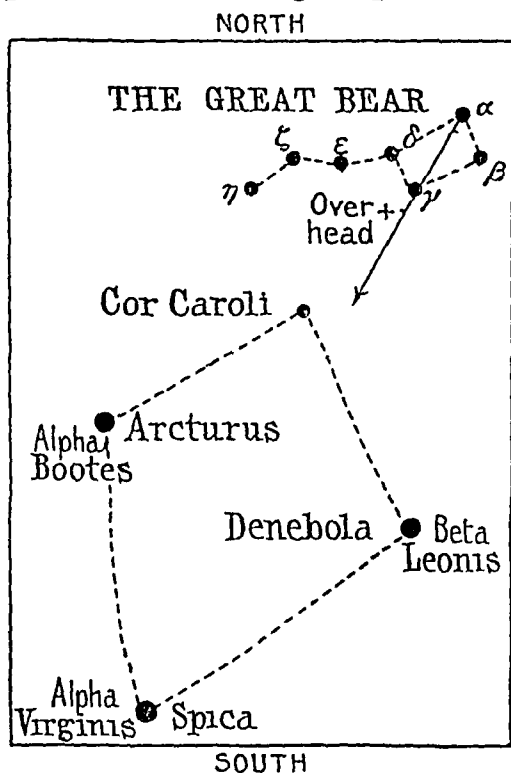


CHART VI—DIAMOND OF VIRGO AS SEEN
IN JUNE

Arcturus in *Bootes*, Denebola in *Leo*,
Spica in *Virgo*, Cor Caroli South of The
Great Bear

Virgo, the Virgin

Spica is a white star of the first magnitude, and it is interesting to compare its colour with that of the glowing Arcturus above. The Arabs called it "the Solitary One," possibly because it seems lonely in that part of the sky, where there are no other very bright stars. The Chinese called it "the Horn", in Egypt it was known as "the Lute-Bearer," but on the Euphrates it had the title of "the Corn Bearer," the Ear of Corn, by which name it is more generally known. Manilius, the poet-astronomer, thus refers to it in the lines describing Virgo —

Her lovely tresses glow with starry light
Stars ornament the bracelet on her hand,
Her vest in ample folds glitters with stars
Beneath her snowy feet they shine, her eyes
Lighten, all glorious, with the heavenly rays,
But first the star which crowns the golden sheaf

In Egyptian mythology Virgo is associated with Isis, who is said to have dropped a sheaf of corn as she fled from the monster Typhon. Thus, the corn scattered along her path became the so-called "yellow road" of the Chinese, another name for the Zodiac.

According to the Greek legend, the Virgin was Astræa, the daughter of Aurora, and the goddess of Justice. On old star maps she is represented holding a sword in one hand and scales in the other, the scales being represented among the stars by the zodiacal sign of Libra.

Evenings with the Stars

In these scales she weighed the good and the
evil deeds of men Aratus describes her as
follows :

The story runs,

That earth was once her home,
And that she mixed in human throngs, nor ever
shunned
Society of man or woman of the olden times ,
But sate among them, immortal though she were,
And bore the name of Justice , and summoning the elders
In solemn senate or wide market-place,
She sang in thrilling strains the notes of equal law
As yet they knew not baleful strife
Nor parted interests, bitter feud, nor battle ,
But lived a life all unalloyed far from the dangerous
sea,
And no ships brought their food from foreign lands ,
But oxen and the plough and throned Justice
Yielded ten thousandfold to all their needs, with distri-
bution due
These things were when earth nurtured the golden
race
The silver race she visited more rarely, with somewhat
altered mood,
No longer finding the spirits of former days
Yet she consorted with the silver race
At eve she would come from the echoing mountains
Uncompanied, nor had she gentle words for any ,
But when she hill-ward drew the thronging crowds,
Her voice was stern, upbraiding their crimes

.

But when that generation died, and there was born
A brazen generation, more pernicious than their sires,
Who forged the felon sword

Virgo, the Virgin

For hostile foray, and tasted the blood of the ox that
drew the plough,
Justice, loathing that race of men,
Winged her flight to heaven, and fixed her station in
that region
Where still by night is seen
The Virgin goddess, near to bright Bootes *

Objects of Interest.—Spica, the Ear of Corn
in the hand of the Virgin, is immeasurably distant from us. It has a companion star which
is invisible even in the most powerful telescope.
How, then, do we know of its existence? That
is where the spectroscope, the Sherlock Holmes
of the sky, comes to our assistance. Starlight
is made up of minute wave-like motions in the
ether which fills space. There are from ten
thousand to one hundred thousand of these
waves to a single inch, and small though they
are, each has a crest like the ocean billows. If a
star is moving in our direction the light-waves
are shorter than when it is moving away from
us. An astronomer finds the length of the waves
by means of a spectroscope or light-sifter.

Now a ray of light from a star passing through
a prism or set of prisms in a spectroscope is
broken up into a rainbow-coloured band, red at
one end and violet at the other. Here and there
the band is crossed by dark lines, which enable
us to learn what the stars are made of and whether

* "The Skies, and Weather Forecasts," pp 5-7 Translated by
E Poste

Evenings with the Stars

the star is approaching or receding from the earth. In the former case, the tell-tale lines are slightly shifted towards the violet end of the spectrum, and in the latter they are shifted towards the red end.

By carefully observing the spectrum of a star in this way it has been found that some stars seem to swing to and fro like a pendulum. The amount of the swing is so slight that it can only be detected by means of a spectroscope, for the most powerful telescope ever made fails to show any movement in the stars. While the star seems to swing backward and forward, the motion is actually around in a circle, but this circle, though millions of miles in extent, is quite invisible at the enormous distance separating us from the stellar object under observation.

The swing is probably caused by the attraction of invisible but massive bodies revolving around the star, as the planets revolve around the sun. The path of the invisible body can be calculated with more or less exactitude. In fact, if there are any astronomers inhabiting those planets, our astronomers on Earth could tell them more about the motion of the world on which they live than the most civilized people a few centuries ago knew of the motions of our planet. Spica's dark companion revolves round it in a short period of about four days.

Spica is one of the nine conspicuous stars used

Virgo, the Virgin

in navigation, enabling nautical men to determine their longitude at sea. The other stars are Arietis, Aldebaran, Pollux, Regulus, Antares, Altair, Fomalhaut, and Markab. They all lie along the Moon's path, so "that a man," says Sir John Herschel, "by merely measuring the moon's apparent distance from a star, with a little portable instrument held in his hand, and applied to his eye, even with so unstable a footing as the deck of a ship, shall say positively, within five miles, where he is on a boundless ocean, which cannot but appear to persons ignorant of physical astronomy an approach to the miraculous. And yet, the alternatives of life and death, wealth and ruin, are daily and hourly staked, with perfect confidence, on these marvellous computations." Spica lies about 2° south of the ecliptic and 10° south of the celestial equator, coming to the meridian on the 28th of May.

The star Gamma Virginis is a double star, easily visible in a small telescope. They are both white, almost equal in magnitude (3 and $3\frac{1}{2}$) and require 185 years to make a complete circuit round their common centre of gravity.

The Latins called this star "Porrina," the name of an ancient goddess of prophecy. It was also known as "the Corner of the Barker," or "the Angle of the Retreat of the Howling Dog," according to the Arabian name, the origin of

Evenings with the Stars

which is unknown A glance at Chart VII will show the star Gamma, midway in a cup-shaped

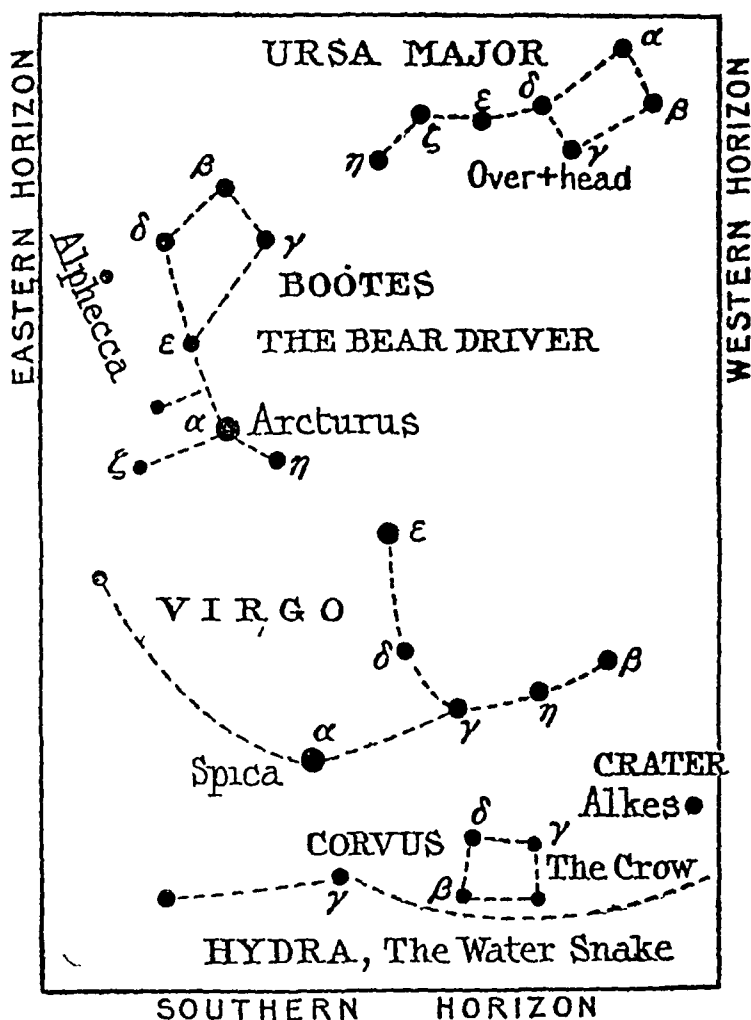


CHART VII—THE GREAT BEAR, BOÖTES, THE BEAR-DRIVER, VIRGO, THE VIRGIN, HYDRA, THE WATER-SNAKE, CORVUS, THE CROW, CRATER, THE CUP

April 20, 100 p m May 1, 9 15 p m

April 23, 9 45 p m May 5, 9 0 p m

April 27, 9 30 p m May 9, 8 15 p m

group of five stars. Beta and Eta are on the right, and Epsilon and Delta on the left, Gamma being the central star. An easy way to remember

Virgo, the Virgin

the order of these stars is by reading the Greek letters naming the stars from Beta to Epsilon, resulting in the word Begde

The star Epsilon in Virgo has for many ages been known as "the Grape-Gatherer," since, like Arcturus, it is observed to rise just before the sun in the season of vintage Hesiod thus refers to Arcturus as a sign of the seasons —

When in the rosy morn Arcturus shines

Then pluck the clusters of the parent vine

Arcturus, as already noted, is the most important star in the constellation Bootes, which is sometimes termed Erigone, the name of the father of Virgo What could be more natural than the idea of Epsilon, one of the handmaidens (let us suppose) of Erigone (Virgo), gathering the grapes for her benefit? This star occupies the uppermost place of the five (Begde) just referred to, and is on the edge of what seems more like a large cup than a Kennel for the "Barking Dog" of the Arabian legend. In the astrology of olden times, the star Epsilon was considered to be a mischief-making star The five stars Begde culminate—that is, they reach their highest point on the meridian—on the 17th of May.

The constellation Virgo is a region wherein there are hundreds of strange cloud-like objects thronging together, a very storehouse of suns and worlds in the process of formation from the

Evenings with the Stars

so-called *nebulæ*. As Tennyson described them in the first edition of *The Palace of Art*, here are :—

Regions of lucid matter taking forms,
Brushes of fire, hazy gleams
Clusters and beds of worlds and bee-like swarms
Of suns and starry streams.

Unfortunately, these *nebulæ*—the star-dust of the Universe—are far beyond the reach of an opera-glass, but it is worth while to know where this region is, and to take the first opportunity that should offer to explore by means of a telescope this mine of wonders for ourselves. We shall then see how the constellation of Virgo seems spangled with stars, fit adornment for “the glittering garments of the goddess Virgo.”

In “Custom and Myth” Andrew Lang refers to the ancient story of the “Maidens of the Wheat-Field,” still seen in connexion with the Northern English and Southern Scottish custom of the Corn, or Kern-baby —

The last gleanings of the last field are bound up in rude imitation of the human shape, and dressed in some rag-tags of finery. The usage has fallen into the conservative hands of children, but of old “the Maiden” was a regular image of the harvest-goddess, which, with a sickle and sheaves in her arms, attended by a crowd of reapers, and accompanied with music, followed the last carts home to the farm. It is odd enough that “the Maiden” should exactly translate the old Sicilian name of the daughter of Demeter. “The Maiden” has

Hydra, the Water-Snake

dwindled, then, among us to the rudimentary Kerna-baby but ancient Peru had her own maiden, her Harvest-goddess *

During the month of August Virgo is setting, "The Retreat of the Howling Dog" having already lost its star Beta South of the western horizon Spica is twinkling brilliantly, thus signaling her farewell message till she returns once more to greet us in the early evening sky of spring

HYDRA, THE WATER-SNAKE

Creeping along the southern horizon below Spica is the water-snake Hydra, with the small constellations of Crater, the Cup, and Corvus, the Crow, balanced on its back Only part of Hydra is shown in Chart VII, as it extends still farther to the right, terminating in the bright star Alphard, which marks its heart (*see* Chart VIII)

One naturally wonders why a crow should be represented as perched on the back of the water-snake, but the explanation is given in a book by M A Orr (Mrs Evershed), entitled "Stars of the Southern Skies" "I have seen (in India) a snake pursued by an Indian crow which kept pecking at its tail until the snake found refuge in a stream"

Corvus, the Crow, is an irregular little square which sailors call "Spica's Spanker"—a spanker

* "Custom and Myth," p 18 Andrew Lang

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being a sail of this shape. Two stars of the four point to Spica, the bright star of the Virgin Crater, the Cup, has only one bright star, which is named Alkes, but no stretch of the imagination can explain the why and the wherefore of its position, tilted at an awkward angle (judging from the old-time picture of this group) on the back of Hydra. However, the original connexion of Crater and Corvus is with Hydra, the ocean monster. Crater was likened to the vault of heaven, that "inverted bowl we call the sky," as described in the *Rubáiyát* of Omar Khayyám, the poet-astronomer of Persia. Within this vault brew storms, winds, clouds and rains, and Corvus, "the Great Storm Bird," was said to be the shape assumed by Phœbus Apollo during the conflict between the gods and the giants.

Legend of Corvus, the Crow.—According to Greek fable, the Crow was placed among the stars by Apollo. This god, being jealous of Coronis, the daughter of Phlegyas, sent a crow to spy on her, and as a fit punishment for its crime of tale-bearing it was changed from purest white to black —

The raven once in snowy plumes was drest,
White as the whitest dove's unsullied breast,
Fair as the guardian of the capitol,
Soft as the swan a large and lovely fowl,
His tongue, his prating tongue, had changed him quite
To sooty blackness from the purest white

Hydra, the Water-Snake

Ovid, in the story of Coronis in the *Metamorphoses*, relates that, when the bird reported unwelcome news to Apollo concerning Coronis, it was changed from its former silver hue to black, as Saxe concludes the story —

Then he turned upon the Raven
“ Wanton babbler ! see thy fate,
Messenger of mine no longer,
Go to Hades with thy prate !

“ Weary Pluto with thy tattle !
Hither, monster, come not back
And—to match thy disposition—
Henceforth be thy plumage black ! ”

This story gave rise to the stellar title *Garrulus Proditor*

Objects of Interest in the Constellation Crater.—
The constellation of Crater, the Cup, though only indicated by its leading star Alkes or Alpha, which is at the bottom of the Cup, is composed of six fairly bright stars (fourth magnitude), forming a beautiful crescent opening to the west. The crescent form of the stars in the Cup is so striking and well defined, when the Moon is absent, that no other description is necessary to point them out. Its centre comes to the meridian about two hours after Alphard (which marks the heart of the Hydra) on the same evening

Alkes is a pretty object when seen in a telescope, but is no longer the brightest star in the

Evenings with the Stars

group. It is of an orange hue, and when observed with the assistance of a telescope two beautiful companion stars, deep red and pale blue in colour, can be seen in the field of view at the same time.

Legends concerning Crater, the Cup.—The old Romans knew it as the Cup of Apollo, Bacchus, Hercules, Achilles, Dido and Medea. It was the Soma-cup of prehistoric India, the cup referred to by the prophet Jeremiah “Babylon hath been a golden cup in the Lord’s hand.”

It was known in England two or three centuries ago as the “Two-handed Pot”, and Admiral Smyth tells us of a small ancient vase in the Warwick collection bearing an inscription which can be thus translated.—

Wise ancients knew when Crater rose to sight,
Nile’s fertile deluge had attained its height.

although Egyptian remains so far have revealed no allusion to the constellation.

The Constellation of Hydra, the Water-Snake.—Map-makers have always shown it as a long winding snake, the Cup resting midway on its back, or as Aratus describes it —

Another constellation from the east
Comes trailing westward, called the Hydra, like
A thing of life roll her long coils her head
Reaches the Crab, her middle folds the Lion,
And over the huge Centaur hangs her tail
The Cup stands on her middle, on her tail
A phantom Crow that seems to peck her spires

Hydra, the Water-Snake

The Egyptians named this winding group of stars after the River Nile, for it extends in a serpentine direction over a space more than one hundred degrees in length, or twenty times the distance separating the Pointers in the Plough (Alpha and Beta) from each other. It stretches from the constellation Cancer to Scorpio, both signs of the Zodiac, which share that honour with Virgo. As described by Eudoxia —

Near the equator rolls
The sparkling Hydra, proudly eminent
To drink the Galaxy's refulgent sea,
Nearly a fourth of the encircling curve
Which girds the ecliptic, his vast folds involve.

When the head of Hydra is on the meridian its other extremity is many degrees below the horizon, so that its whole length cannot be traced out in the heavens until its centre on which the Cup is balanced is on the meridian. (This explains why Hydra required the two Charts, VII and VIII, to show its winding outline.)

To see the constellation Hydra at its best, one must journey to southern climes, where, as the writer has often seen it in New Zealand and Australia during the months of February and March, the Water-Snake trails its length from midway between the point overhead and the eastern horizon and nearly half-way across to the north-west. Alphard (Alpha), which marks the heart of the Hydra (Cor Hydræ), then appears

Evenings with the Stars

alone in its glory, "the Solitary One," as it is sometimes termed on account of its isolated

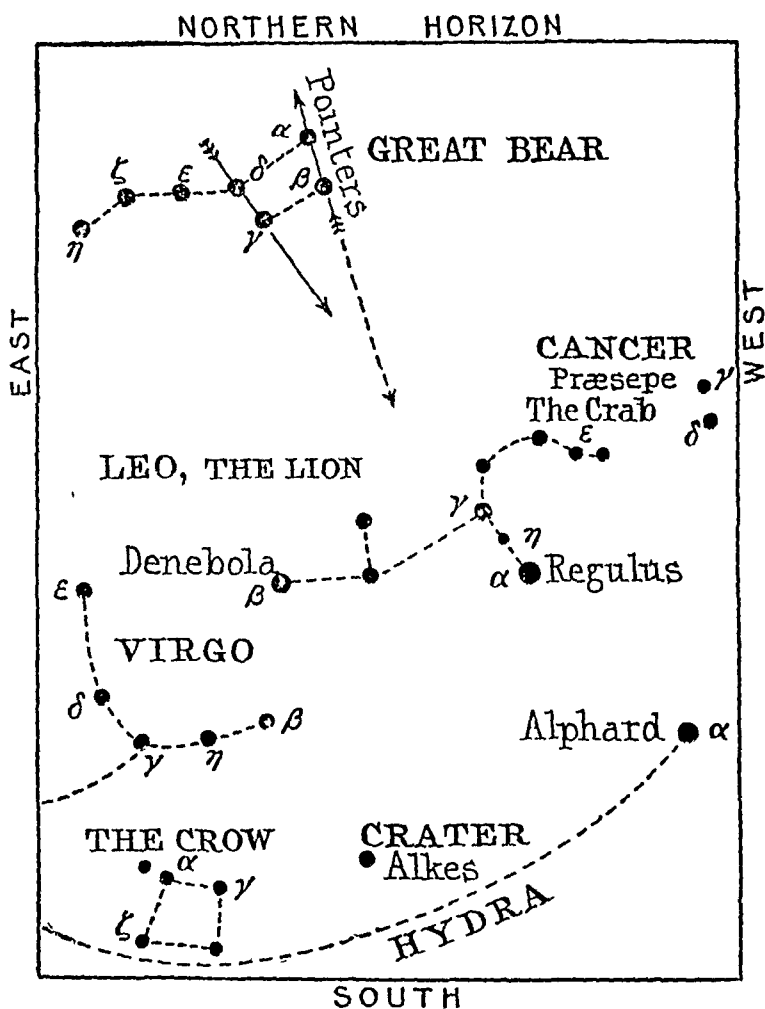


CHART VIII—THE GREAT BEAR, LEO, THE LION, VIRGO, THE VIRGIN, CANCER, THE CRAB, HYDRA, INCLUDING ALPHARD.

May 1, 9 15 p m
May 5, 9 0 p m
May 9, 8 45 p m

May 13, 8 30 p m
May 17, 8 15 p m
May 21, 8 0 p m.

position in the sky There is an odd fascination about these lonely stars which seem to peer at us from out the depths of space.

Hydra, the Water-Snake

Hydra is a constellation which has changed in position owing to the mighty reeling motion of our earth

When the constellations were first formed, the Sea Serpent extended along the equator, and I think originally represented the great serpent which was supposed to gird the ocean. I have sometimes thought that when this constellation was framed (and Cetus, too) there may still have remained some few of those long-necked paddling sea-monsters whose skeletons are found from time to time in various parts of the earth. Mr Gosse, in a sketch, called the "Great Unknown," maintains that there are still a few of these monsters left, who being seen from time to time with their long necks reared above the sea, have been regarded as sea-serpents. And, even though this may be unlikely or impossible, as Professor Owen seems to think, one may well believe that such monsters were either known or remembered three or four thousand years ago *

Legends of Hydra. — In Greek mythology, Hydra was the great water-snake destroyed by Hercules. It was said to have had one hundred heads (some say, only nine), and, according to the picture of the contest between Hercules and the Hydra shown in the Uffizi Gallery at Florence, it was indeed a fearsome monster. As fast as Hercules struck off one of the heads, two new ones appeared in its place. The task of slaying the monster seemed hopeless, until Iolaus, the nephew of Hercules, came to the rescue and suggested burning off the heads of the serpent.

* "Easy Star Lessons," p 89 R. A. Proctor

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This was successfully accomplished, but Juno, annoyed at the contest ending in favour of Hercules, sent a crab which bit his foot this the giant trod on, much to Juno's disgust.

In the Zodiac of Denderah, and in most of the astrological remains of Egypt, a scarabæus or beetle is used as a symbol of this sign, but in Sir William Jones's "Oriental Zodiac," and in some others found in India, we meet with the outline of a crab. As the Hindus probably derived their knowledge of the stars from the Chaldeans, it is supposed that the figure of the crab in this place is more ancient than that of the beetle.

FIFTH EVENING

LEO, THE LION , CANCER, THE CRAB

BEGINNING our fifth evening with the stars, we look around as usual for our faithful guide, the seven stars of the Great Bear. They are still occupying a prominent position overhead, with the Pointers showing the way to the Pole-star. Let us this evening, however, imagine the arrow through Alpha and Beta pointed in the opposite direction. A glance at Chart VIII will show that it is now aimed at the Lion, but the arrow through Delta and Gamma if continued onward would pierce Regulus, the Heart of the Lion. Denebola marks the tip of its tail, and a sickle-shaped group of stars outlines its head.

Leo is one of the twelve signs of the Zodiac, which is, as it were, a girdle in the heavens about sixteen degrees in breadth. The centre of the girdle is the Ecliptic, along which the Sun appears to describe its journey annually among the stars. It has sometimes been termed "the Sun's Highway." Eight degrees on either side of the Ecliptic is the region within which the planets and their attendant satellites make their

Evenings with the Stars

journeys. It has not inaptly been compared to—

. . . a broad belt of gold of wide extent,
Wherein twelve starry animals are shown,
Marking the boundaries of Phœbus' zone.

(LUSIADAS.)

The Zodiac has been variously known as the Solar Walk, the Monthly Abodes of Apollo, the Houses of the Sun, the Millwheel, whose cogs were represented by the twelve signs, and centuries ago it was described in the *Rig Veda* of India as "the twelve-spoked wheel" China has a zodiac consisting entirely of animals, a veritable celestial Zoo, including the tiger, the ape, the horse, and even the rat. The Chinese Zodiac was known as "the Yellow Way," and began with the rat, which corresponded with the constellation of Aquarius, the Water-Bearer.

The ancients divided the Sun's annual path into twelve constellations, known as the "Signs of the Zodiac," derived from the Greek word *zo-on*, an animal Their order is as follows —

The Ram, the Bull, the Heavenly Twins,
And next the Crab, the Lion shines,
The Virgin, and the Scales,
The Scorpion, Archer, and Sea Goat,
The Man who holds the Watering-pot,
And Fish with glittering scales

"This annual motion of the Sun was discovered in very early times, and even its exact path among the stars marked out, a very diffi-

Leo, the Lion

cult task, for the ancients could not see the stars by day, nor indeed for half an hour after sunset. They made use of the Moon as a stepping-stone, it can often be seen by day. At such times they compared it with the Sun, and afterwards with the stars after sunset; they also carefully observed the stars that could be seen nearest to the Sun's place before sunrise or after sunset. Such stars were said to rise or set 'heliacally' (Greek, *helios*, with the sun)." *

The introduction of the twelve figures of the Zodiac into the walls or pavements of early churches and cathedrals is prevalent in Europe. Thus, in Cologne Cathedral, an elaborate design outlining the twelve signs is to be seen graven on the pavement in front of the choir, and it also forms the subject of a stained glass window to the right of the great door at the entrance. Still more frequently are the zodiacal signs to be found used in decorative form in the temples of the East, the zodiac at Denderah, where the lion is represented standing on an outstretched serpent, being among the most famous. This shows the importance attached to these signs by the Egyptians in the olden times. According to the historian Pliny, the stars of Leo were worshipped because the inundation of the Nile occurred when the Sun was passing through that sign.

The Egyptians were much annoyed by lions

* "The Star World," pp 17-18 A C Crommelin

Evenings with the Stars

during the heat of the summer, for at that season these animals left the desert regions and haunted the banks of the Nile, which by that time had reached its greatest elevation. Thus the Lion, as an emblem of violence and fury, became one of the signs of the Zodiac.

According to Greek and Roman myth, this group of stars was supposed to represent the Nemean lion which came originally from the Moon. After a brief stay on earth, during which time it was a source of terror and destruction, it was later carried back to the sky with its slayer Hercules, becoming the Nemesis described by the poets.

“The Sun glows in the Lion,” says Seneca, meaning that when the Sun enters the sign of Leo the greatest heat of the year is felt. Aratus, in “The Stars, and Weather Forecasts,” alludes to Leo, as follows —

Most scorching is the chariot of the Sun,¹
And waving spikes no longer hide the furrows,
When he begins to travel with the Lion
Boisterous north-winds periodic then fall on
broad ocean
With all their weight, no time is that for oar-
sped barques
Broad-beamed ships be then my choice,
And, helmsman¹ keep the stern before the wind

Owing to the change wrought by the precession, or slipping back, of the equinoxes, so that the constellations no longer fit the signs,

Leo, the Lion

the Sun in ancient times entered the constellation a month earlier than it does now, at a time when the heat of summer was greatest.

Objects of Interest in the Constellation Leo.—The brightest star in the constellation is Regulus, and it was called *Basileus*, equivalent to "King of the Sky," by the Greeks, *Cor Leonis*, the Lion's Heart, the Mighty, the Great One, the Hero, and in Akkadia it was associated with the 5th antediluvian King-of-the-celestial-sphere, Amil-gal-ur. A Ninevite tablet records

If the star of the great Lion is gloomy, the heart of the people will not rejoice

For in those days astrology was an accepted science. Warnings such as those described in the following lines by Coleridge were then carefully heeded —

. Come and see, trust thine own eyes
A fearful sign stands in the house of life,
An enemy, a friend lurks close behind
The radiance of thy planet—oh, be warned!

Regulus is one of the nine stars already referred to as useful in determining longitude at sea, since it is a conspicuous star lying along the Moon's path. In colour it is a dazzling white, with a small companion star which looks as though it had been steeped in indigo, to judge from its steely blue tint. It is far beyond the range of a field-glass, but with a very powerful telescope one can see that it is also a double star.

Evenings with the Stars

The star Gamma (see its position as marked on Chart VIII) is also a beautiful double star, its small attendant being visible with an opera-glass. The larger star is orange, and the smaller one of a greenish hue. Even without looking at the chart, Gamma is easily found, as it is just above Regulus, and it is the brightest star in the blade of the Sickle. It is interesting to compare the colour of the star Regulus, which is white, with that of Gamma with its golden-yellow hue, and then glance at the orange tint of Arcturus, in Bootes, near by (see Chart VII). The contrast is startling, and still more so when the observation is made with a powerful field-glass.

By means of the colours of the stars it is possible to determine through which period of its life-history a star may be passing, for the span of life in our planet is too short for us to see a star progressing through all its changes. We know that the nebulous stars are as yet in the infancy of their careers, the brilliantly white or blue stars are in the heyday of their youth; yellow stars indicate middle age, and an orange or ruby-coloured star shows symptoms of old age and approaching decay. Eventually, its light flickers and fades from view, and it then joins the vast assemblage of "Dark Stars" in the sky. It is as possible for a scientist to reconstruct this cycle of changes in the life-history of a star as it is for a botanist to obtain

Leo, the Lion

a record of the evolution of a mighty oak some centuries old from the acorn in which it started its career, by the simple process of examining specimens of oaks at various stages of their growth.

The radiant point of the famous November meteors, which made such a magnificent display in 1833 and 1866, is near Gamma Leonis.

Denebola, the second brightest star in Leo, has a bluish tinge in its colour. South of it is a little star which is of the sixth magnitude and just visible to the unaided eye. With a powerful field-glass it is possible to see another faint star, one of the many "companions" of Denebola, for which that star is celebrated. It has a curious way of playing hide-and-seek with the observer, so that one has to be up to its tricks, as it were, by making use of what is called "averted vision."

That is, you look in vain for a faint star, then you glance towards the edge of the field of view, while you know the object you are seeking is at the centre, and you manage to glimpse it out of the corner of your eye. However, the instant you direct your eyes straight at it—presto! it has gone, and so it will continue to dodge in and out of sight as often as you turn your eyes in its direction.

The star Denebola is one of those forming the so-called "Diamond of Virgo," consisting of

Evenings with the Stars

the four stars Denebola, Arcturus, Spica, and Cor Caroli, an insignificant star in the neighbourhood of the Great Bear. (See outline of "Diamond of Virgo," in Chart VI, and note also how a line through Alpha and Gamma in the Great Bear points to the bright star Spica, in Virgo.)

CANCER, THE CRAB

By the Greeks, the constellation of Cancer was identified with the Crab which attacked Hercules when he was fighting the Hydra. In the old Egyptian zodiacs it was represented as a beetle, but only the two stars Gamma and Delta can easily be detected. A glance at Chart VIII will show that they are in close proximity to the Lion. Between these stars, the so-called Aselli or Donkeys, is a hazy-looking cloud known as Præsepe, the Manger, which is also called the "Bee-hive." This group of stars can easily be seen with an opera-glass, but better still with a large field-glass. The misty cloud is perceptible with the unaided eye when the atmosphere is perfectly clear, and for this reason, mariners look upon it as a sign of fair weather. Aratus bids us—

Watch the Manger like a little mist,
Far north in Cancer's territory it floats
Its confines are two faintly glimmering stars;
These are two asses that a manger parts,

Cancer, the Crab

Which suddenly when all the sky is clear
Sometimes quite vanishes, and the two stars
Seem to have closer moved their sundered orbs.
No feeble tempest then will soak the leas,
A murky manger with both stars
Shining unaltered is a sign of rain

The imagination of the ancients pictured the Aselli feeding from their silver manger

Although Cancer, the Crab, is such an insignificant-looking figure in the Zodiac, yet few heavenly signs have attracted more notice in the days of old. According to the philosophy of the Chaldeans and followers of the doctrines of Plato, it was the supposed "Gate of Men," through which souls descended from heaven into human bodies. It was identified by Lalande with Anubis, one of the divinities of the Nile country commonly associated with Sirius. When the Sun was within its boundaries every thunder-storm would cause famine and locusts, and Berossos asserted that the Earth was to be submerged when all the planets met in Cancer, and consumed by fire when they met in Capricorn. It was known as the "Northern Gate of the Sun," whence that luminary commences its retrograde movement. (As a matter of fact, all the planets except Neptune were in the same part of the sky as Cancer in 1895, an unusual and most interesting occurrence.)

Evenings with the Stars

The Sun arrives at the *sign* Cancer about the 21st of June, but does not reach the *constellation* until the 23rd of July. The beginning of the *sign* Cancer is called the Tropic of Cancer, and when the Sun arrives at this point it has reached its utmost limit of north declination, where it seems to remain stationary a few days, before it begins to decline in the south.—This stationary position of the Sun is called the Summer Solstice, from two Latin words signifying “the Sun’s standing still”

Objects of Interest in Cancer.—Turning an opera-glass in the direction of *Præsepe* the Manger, it appears to be crowded with so many small stars that it is difficult to count them. When observed with a powerful field-glass, however, the spaces between the stars open out, and it is then possible to do so. Galileo has left a delightful description of his surprise and gratification when he aimed his small telescope at this curious cluster, and discovered that the misty cloud was in reality a group of faint stars.

There are several double and nebulous stars in this constellation, but a telescope is required to show them. For instance, there is a star so faint that it is only of the fifth magnitude, yet it is visible to the naked eye, which can—providing the eyesight is excellent—detect stars down to the sixth magnitude. This star is known as Zeta, and, as some of my readers may have a

Cancer, the Crab

small telescope and a desire to see it for themselves, its position is indicated with a few of the other wonders around this region, in Chart IX,

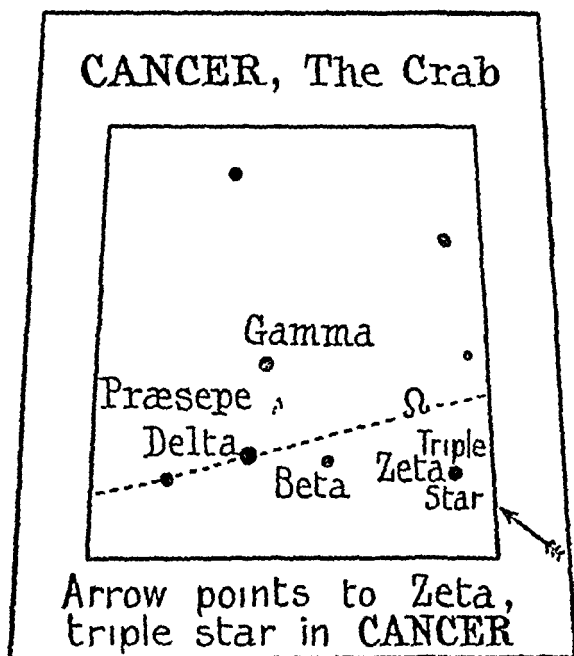


CHART IX—CANCER, THE CRAB, SHOWING ZETA, A TRIPLE STAR, ALSO POSITION OF PRÆSEPE, THE MANGER, AS SEEN IN JUNE

taking my father's "New Star Atlas," Map 6, as guide

Zeta is composed of three yellow stars which form one system. They are all connected by the wonderful law of gravitation, which holds every particle in the Universe under its control and sways them by its hidden power. So intricate are the movements of the celestial trio as they advance and recede in their dance, that

Evenings with the Stars

learning their steps proved a difficult task at first for observers on our planet. Yet the problem has been partially solved, and may be explained as follows.

Let us call the stars A, B, and C. While the motions of A and B are more or less straightforward, those of C were for a long time considered rather puzzling. The star C apparently reverses around A and B at an average rate of half a degree a year, requiring a period of 600 or 700 years to make one complete turn, or revolution, to use the technical term. But its path is anything but a smooth curve. It is rather a series of loops in traversing which C alternately advances and recedes, sometimes quickly, sometimes slowly, even hesitating at times as if uncertain as to its next step, while at the same time it is ever increasing or diminishing its distance from the centre of motion. Some say the star C is merely a partner to a dark star round which it is describing an oval-shaped path in seventeen and a half years. Together this singular couple circles or is circled by A and B, the invisible disturbing star being quite possibly the most massive in the system. As Miss A. M. Clerke describes it in her book entitled "The System of the Stars"

Here a cool, dark globe, clothed possibly with vegetation appropriate to these strange climes, and

Cancer, the Crab

plentifully stocked, it may be, with living things, is waited on for the supply of their needs by three vagrant suns, the motions of which it controls, while maintaining the dignity of its own comparative rest or rather of its lesser degree of movement. For the preponderance of this unseen body cannot approach that of a sun over its planets, hence its central position is by no means undisturbed. We must not forget meantime that its existence is to some extent hypothetical.



SIXTH EVENING

HERCULES, THE KNEELER , OPHIUCHUS, THE SERPENT-BEARER , AND SERPENS, THE SERPENT

Near to the Dragon's head, in toil-spent posture,
Revolves a phantom, whose name none can tell,
Nor what he labours at , they call him simply
The Man upon his knees , his knees seem bent
In desperate struggle , while from his shoulders
His hands are high uplifted and outspread
As far as he can stretch , his right foot's sole
Is planted on the crest of the coiled Dragon.

(ARATUS)

WE now come to the constellation of Hercules, which occupies a large space in the heavens, between the constellation Draco and the point overhead. The hero is represented on old maps as resting on one knee, with his left foot on the head of the dragon which grasps his heel. The star Iota marks the heel of the giant, who has been called "the Kneeler" (*Engonasín*) from time immemorial. He must have been an important figure in the old zodiac temples, and not improbably his presence there as one of the largest and highest of the human figures may have caused a zodiac-dome to be named after him. The head of the giant, marked by the star Alpha (Ras Algethi), is nearly within ten

Hercules, the Kneeler

degrees of the Ecliptic. In fact, this constellation extends from 12° to 50° north declination, and as observed by the dwellers in Arabia and Chaldea, in the olden times, must have presented a far more imposing appearance than it does as seen in more northern latitudes

The constellation is intended to immortalize the name of Hercules, the Theban, so celebrated in antiquity for his valour and prowess. The twelve labours of Hercules, imposed upon him by Eurystheus, who was jealous of this hero's fame, are supposed to be a figurative representation of the annual course of the sun through the twelve signs of the Zodiac, Hercules presumably representing the Sun. Eventually, after a series of adventures, he was carried up to the sky in a chariot drawn by four horses.

Almighty Jove

In his swift car his honoured offspring drove,
High o'er the hollow clouds the coursers fly,
And lodge the hero in the starry sky

Ovid's *Metamorphoses* Lib ix, v 271

The centre of the constellation of Hercules is on the meridian about the 21st of July, when it occupies the position shown in Chart X. This is the best time of the year for making the acquaintance of this notable group of stars

Objects of Interest in Hercules.—The constellation Hercules is a veritable mine of celestial wonders, and allowing for summer time, the

Evenings with the Stars

accompanying chart has been so planned that the observations actually begin at 9 o'clock.

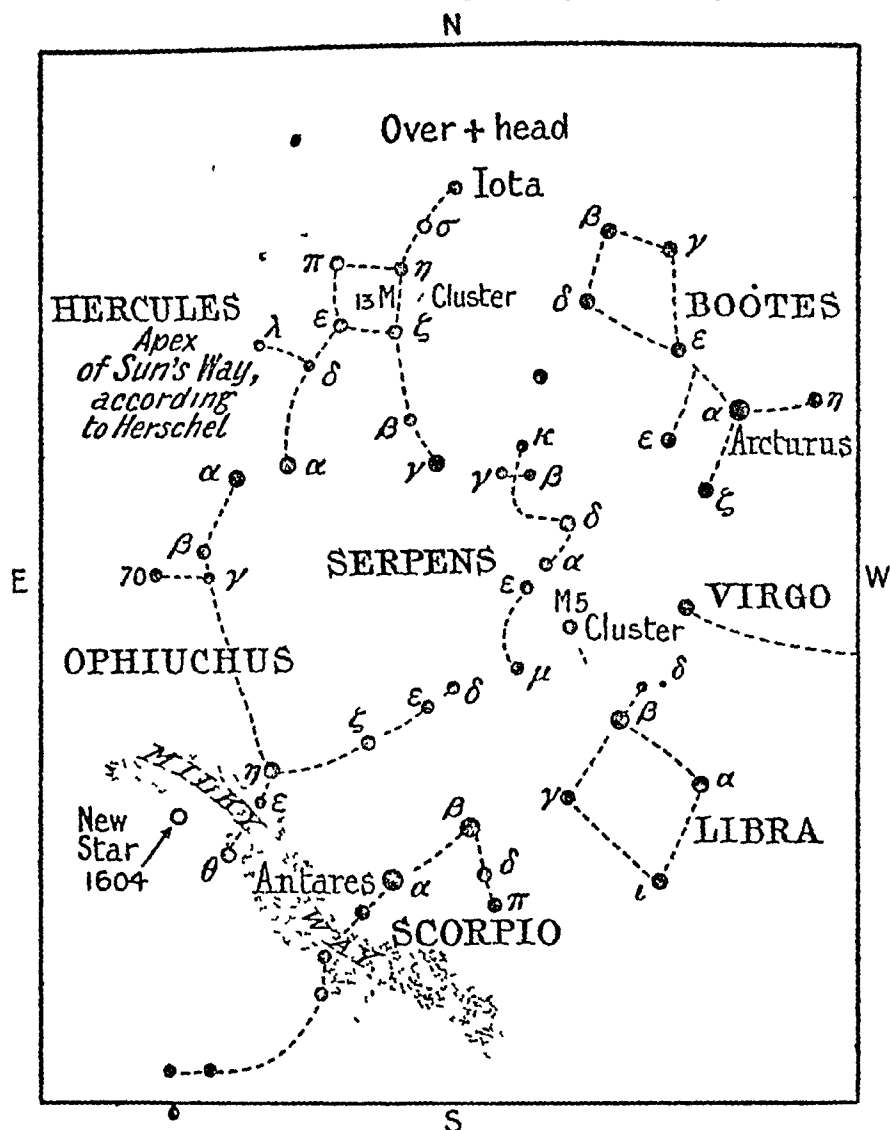


CHART X—HERCULES, BOÖTES, OPHIUCHUS, SERPENS, LIBRA, SCORPIO
June 21, 100 pm July 21, 80 pm

Hercules, Ophiuchus, and Serpens are the attractions selected for this evening, the remainder being reserved for the seventh. Selecting a place in the garden, or if nothing better offers, the

Hercules, the Kneeler

balcony of the house (should you be in the city during the summer months), and provided with a reclining chair or a hammock with a comfortable cushion on which to rest the head while star-gazing, will prove a delightful way of passing the ten minutes devoted to tracing out this star-group

First of all, note Iota, now almost exactly overhead, then look at a keystone-shaped square formed by the stars, Eta, Zeta, Epsilon, and Π at the north-east corner. On its western boundary, a third of the way from Eta towards Zeta, lies the remarkable cluster of stars discovered in 1714 by Halley, and known as 13 Messier.*

It is the finest of all the clusters in the northern skies, and is just visible to the unaided eye on a dark night. With an opera-glass, the cluster presents the appearance of a faint hazy speck, with a little star on each side, but when Herschel examined it with his great reflector, he computed that the "speck" must contain at least fourteen thousand stars. Nowadays, by means of photography, it has been possible to obtain a close-up view, as it were, of what may be termed literally a ball composed of thousands of suns,

* Messier was a French astronomer who made a specialty of comet-hunting, but was sometimes led astray by the appearance of hazy-looking objects which on closer inspection proved to be nebulae or clusters. Accordingly their position was noted and catalogued, so that the mistake of recording them as comets might not be repeated. Thus, the cluster in Hercules was the thirteenth on this list, and it is usually referred to by this number, as 13 Messier.

Evenings with the Stars

with outlying streamers curving outward as though wafted by a celestial breeze. A glance at the magnificent photograph of this cluster, obtained with the great 72-inch reflector at the Dominion Astrophysical Observatory, Victoria, B C, and selected as frontispiece to this book, will convey an idea of the wonders of this display far more than descriptive words. The glamour of the light from these intermingled stars remains for the fortunate observer who has the privilege of actually *seeing* them through the giant reflector.

The cluster is a mass of glittering starlight, each star a sun pouring forth supplies of light and heat, and all the electric and chemic influences which are as necessary as light and heat for the welfare of living beings—if any such exist—on planets circling around these orbs. That such planets may exist we infer from the varying light of stars in the cluster, as though partially obscured at times by dark orbs—such as a planet—coming between us and the stars at different periods. If such worlds in space are a reality, and if they are inhabited by reasoning beings like ourselves, it is a fascinating idea to imagine what must be the appearance of the sky to dwellers on a planet circling around one of the stars in the centre of such a cluster as 13 Messier.

In this little colony we might think of the

Hercules, the Kneeler

inhabitants of planets holding intercourse with other worlds by means, let us say, of wireless communication Yet could we be transported to one of those distant clusters, instead of finding the neighbouring suns with their accompanying world close by, we should see a firmament of stars around us, such as we see from the earth Probably it would be a much brighter sky, in which so many stars would glow with more than the splendour of Sirius as to make the night far brighter than ours, but the inhabitants of the neighbouring worlds would as completely elude telescopic vision as the supposed inhabitants of Mars do here Consequently, to the inhabitants of every planet in the cluster, the question of the plurality of worlds might be as great a problem as it is to us

Taking it for granted that there are worlds within that cluster then, for their benefit, there must be a perpetual supply of light and heat To quote from my father's book, "The Expanse of Heaven" (pp 217-218) —

Stars must be always rising and setting, only the magnificent colours which adorn our skies at sunrise and sunset must be wanting there, banished by the excess of splendour Each world must seem to the ordinary senses of its inhabitants the centre of the universe—the largest, finest, and most important of all created objects. For the blaze of light from the thousand thousand stars of their firmament must blot out all light from beyond Their whole sky—by which I here mean

Evenings with the Stars

the illuminated air which in the case of our own daylight limits our range of view, and forms a veil beyond which we cannot penetrate—their whole sky must be far more resplendent than ours, because every part has its hundreds and hundreds of suns. In this great splendour exists a perpetual limit to all extension of their researches into the constitution of the universe. The light of their myriads of suns blinds them to lights which lie beyond, their system of suns is their universe, and though the universe thus revealed to them is magnificent and stupendous, yet we can see how minute it is compared with what is revealed to ourselves when we remember that we can perceive many hundreds of such systems of suns.

This passage is taken from a book written by my father more than fifty years ago, long before the erection of the great telescopes of to-day, or the introduction of stellar photography which has opened so widely new avenues of research in the realms of Starland. For instance, from an examination of the photograph of the celebrated cluster in Hercules, taken with the great reflector at Victoria, B.C., it is estimated that the number of stars is more than a hundred thousand in a space not as large as would be covered by the disk of the moon. In view of this fact, Herschel's count of stars in the Hercules cluster is comparatively insignificant, and yet the meaning of the display in either case is undoubtedly stupendous.

Each of these stars, it should be remem-

Hercules, the Kneeler

bered, is a sun, and according to the well-known authority Professor Shapley, Director of the Harvard Observatory, U S A , there are fifty thousand stars in the cluster that exceed our sun more than a hundred times in brightness. He estimates the distance of the cluster to be such that a ray of light would require several hundred years in crossing the abyss separating it from our planet. Therefore, the message of starlight imprinted on the photographic plate from each star in the cluster must have been hundreds of years on its way. The following lines aptly express this stupendous fact

How distant some of these nocturnal Suns !
So distant (says the Sage) 'twere not absurd
To doubt, if Beams set out at Nature's Birth,
Are yet arrived, at this so foreign World
Tho' nothing half so rapid as their Flight

Or, to quote Longfellow's *Ode to Charles
Summer*

Were a star quenched on high,
For ages would its light
Still travelling downward from the sky
Shine on our mortal sight

Before leaving this fascinating subject, there is just one more consideration of importance to which our attention has been called by Professor Newcomb. After noting that among the stars in general, single stars are the exception, and that double stars are apt to prevail among

Evenings with the Stars

the condensed clusters, he makes the suggestion that —

Perhaps the most important problem connected with clusters is the mutual gravitation of their component stars. Where thousands of stars are condensed into a space so small, what prevents them from all falling together into one confused mass? Are they really doing so, and will they ultimately form a single body? These are questions which can be satisfactorily answered only by centuries of observation, they must, therefore, be left to the astronomers of the future.

In the consideration of all these wondrous facts and theories, one cannot but see something of the meaning Pope intended to convey in the following lines —

He who through vast immensity can pierce,
See worlds on worlds compose one universe,
Observe how system into system runs,
What other planets circle other suns,
What varied being peoples every star,
May tell why Heaven has made us as we are

Other Objects of Interest.—The leading star in the constellation Hercules is Alpha (Ras Algethi), marking the head of the giant. It is a splendid double when seen with a powerful telescope, the components being orange and emerald green. The writer can never forget the feeling of amazement with which she gazed at this celestial gem through the 12-inch lens at the Yerkes Observatory, nor the exclamation of delight when it was glimpsed by an observer who told her to come quickly and look at Alpha

Hercules, the Kneeler

Herculis, then in the field of view of the telescope. This was one of the red-letter day experiences indelibly recorded in her memory. The star Alpha is a notable variable, changing from magnitude 3 to $3\frac{1}{2}$ in a period of $66\frac{1}{3}$ days, as though a celestial lamplighter were employed in the task of successively raising and lowering its light. The variability of Alpha was discovered by Sir William Herschel in 1795. During some years the swing appears to cease, as though the lamplighter had forgotten his task and then hurriedly resumed it, but whatever the actual explanation of the star's variability may be it is certainly inclined to no settled period.

Gamma Herculis is a large star with a small companion, their colours being respectively white and lilac. Another beautiful double star is Delta, with contrasting colours in the components of green and purple. There are many other such instances of double stars, but a telescope is required to reveal their presence. The name of a book is suggested to the enthusiast who wishes to see them, with information as to where these stars are to be found.*

The star Lambda (see position marked on Chart X near Delta) is of special interest because in Sir William Herschel's efforts to determine the direction of the Sun's motion among the stars, he settled upon a point in the neighbour-

* "Celestial Objects for Common Telescopes" T W Webb

Evenings with the Stars

hood of this star as the *Apex of the Sun's Way*. His determination was approximately correct, though more modern data has shifted its position to within four degrees of the star Vega in the constellation of Lyra.

Herschel treated the matter in the simplest way possible: by selecting seven stars and striking a balance between their proper motions, he was led by the unerring instinct of genius to a conclusion nearly correct. We are told that he himself regarded his attempt as nothing more than an experimental effort. In a letter to Dr. Wilson, of Glasgow, he expressed his apprehension lest his paper on the Sun's motion "might be too much out of the way to deserve the notice of astronomers."

But think of the meaning of this discovery, and picture to yourself the Sun with its accompanying flotilla of planets travelling onward at the rate of millions of miles in a year. The more one considers this celestial journey the stranger seem the adventures of the solar system in its stupendous journey through space. The wildest imaginings of the Eastern story-tellers, with their magic horses and enchanted carpets, seem spiritless in comparison with what science has to tell us of this wonderful journey in which we are all unconsciously engaged. Who would not wish to witness with an all-seeing eye this caravan of worlds as it drifts onward through space?

Ophiuchus, the Serpent-Bearer

Always gathering new material from the depths of space, adding comets and meteor-swarms to its domain, the Sun sweeps on, and the planets which are under its control are bound to follow, but whither they are going, and how the journey will end, even science cannot foretell

OPHIUCHUS, THE SERPENT-BEARER

the length of Ophiuchus huge
In th' arctic sky —*Paradise Lost* (Milton)

Beyond Hercules is the constellation Ophiuchus, who is represented in olden maps as a venerable man clutching a writhing serpent with both hands. In Greek mythology he was Æsculapius, the great physician, who, it was said, could even restore the dead to life. Pluto, the god of the Underworld, becoming alarmed at the threatened depopulation of Hades, persuaded Zeus to remove the physician to the sky, where he could do no more harm. According to Manilius.—

Next Ophiuchus strides the mighty snake,
Untwists his twining folds, and smooths his back,
Extends his bulk, and o'er the slippery scale,
His wide stretch'd hands on either side prevail
The snake turns back his head and seems to rage.
That war must last where equal power prevails

A glance at Chart X will show the extensive space covered by these two groups of stars, and while the outline of a serpent is easily

Evenings with the Stars

detected, yet that of Ophiuchus seems more like a gigantic cup, or, as someone suggested, a lotus-flower, which makes it easier to trace its outline. The star Alpha marks the head of Ophiuchus closely adjoining the star Alpha in Hercules.

Objects of Interest in Ophiuchus.—While there are no objects of special interest in this constellation for the observer with an opera-glass, yet with its help more can be seen than with the unaided eye. For instance, it is worth while turning it in the direction of Alpha, the star adorning the head of the Serpent-Charmer Ophiuchus. It is composed of a blue star of the second magnitude. Beta is a yellow star of the third magnitude and, with Gamma near by, it serves as a guide to the position of a double star (shown on Chart X) known as 70 Ophiuchi.

During the month of August in the year 1910 it was the writer's special privilege to get a glimpse of this binary through the great 40-inch lens of the Yerkes telescope, owing to the kindness of the late Professor S W Burnham, so renowned for his discovery of double stars. One clear evening, while the twilight still held sway and the stars were as yet too faint to be seen with the unaided eye, Professor Burnham went to the dome at the Yerkes Observatory,* preparatory to making his arrangements for ob-

* Yerkes Observatory is at Williams Bay, Wisconsin, U S A

Ophiuchus, the Serpent-Bearer

serving the stars through the great 40-inch refractor By the time he had everything in readiness the brighter stars could be seen coming out shyly one by one, led by ruddy Arcturus, apparently blushing at his own temerity

The impressive silence of the dome was unbroken, save for the rhythmical sound of the driving-clock by which the telescope is made to follow the stars The birds outside could be heard twittering to each other as they settled to rest beneath the eaves of the observatory roof A faint glimmer of starlight gleamed through the opening in the dome, like twinkling eyes watching the astronomer at his work

He had already turned the telescope to a region of the sky seemingly devoid of stars, but on looking through the eyepiece, two bright stars close together, showing a sociable tendency, could be seen gleaming against the grey-blue background of the sky There was the double star known by the prosaic name of "70," and this was the first time the writer had had an opportunity to see it, and under such exceptional circumstances At first, it presented the appearance of a brilliant point of light glittering with a golden-red hue, and shining in solitary grandeur As the eye became accustomed to the glare, a tiny red star could be detected nestling within the golden haze of the larger star.

It has been suggested that there may be a

Evenings with the Stars

third and invisible companion, though so far the suspicion has not been verified. We only surmise that it is there on account of the swaying, uneven motion attributed to the companion stars, as though they were trying to oppose the invasion of an alien. Apparently they are of the opinion that "two is company, three is a crowd."

If the disturbing object is a planet like our own, basking alternately in the rays of light from the red and the golden sun, what a strange diversity of colour effects must prevail on a world so illumined! Supposing there are inhabitants endowed as we are with reasoning powers and the gift of artistic perception, how impressed they must be at dawn, as the red sun rising above the eastern horizon suffuses the sky with a glow of roseate hue, mingling its rays with those of the golden sun in the west. The blending tints producing an orange hue must give the sky the appearance of a sea of burnished gold. On its surface, the imagination pictures drifting clouds reflecting on the side turned towards the west, the afterglow of the golden sun, and on the side turned towards the east, the ever-deepening crimson hue of the red sun as it slowly emerges above the eastern horizon. It would be undoubtedly a scene of beauty beyond the power of words to describe, or an artist to portray.

But these dreams of far-off worlds in starland



REGION OF NEBULA, *RHO OPHIUCHI*, SHOWING 'VACANT REGIONS
OF THE SKY

Photographed by Professor E. E. Barnard at the Yerkes Observatory

Ophiuchus, the Serpent-Bearer

were suddenly disturbed by a strange whirring sound due to the driving-clock. When the clock weight reaches the end of its descent within the pier, it touches a button, turns on a switch, and winds itself up by means of a motor. By shifting a gear the rate of the clock may be changed to make the telescope follow either the Sun, Moon or stars, whichever may be under observation. On the present occasion, it was set to follow the double stars selected by Professor Burnham.

Among others, the telescope was turned towards a party of three stars in Ophiuchus, which form a little system of their own, since observations made since the days of Herschel have confirmed his theory that they are journeying through space together. In the case of some double stars, the components appear to advance and recede like dancers in a stately minuet, each step, to and fro, however, requiring in some instances hundreds of years. The stars "70" make their circuit around their common centre of gravity in eighty-eight years.

Yet, as seen from a distance, some of these stars are apparently so close together that they might be compared to two friends with linked arms. Others are drifting apart for the time being, to be reunited after many years. Then there are a number under careful observation which seem to be double, but may prove to be but celestial wayfarers passing each other on

Evenings with the Stars

the highway in space, as they go in opposite directions, and some are drifting along parallel paths, but on opposite sides of the road, as it were, betokening the fact that they are not on intimate terms. Years of observation are required to determine these interesting facts, first suspected by Sir William Herschel, and later confirmed by astronomers who have made double-star observations a speciality. These observations have proved beyond doubt that the law of gravitation reigns supreme in the universe.

From the binary stars came a whisper across the vast abyss of space. The whisper told us that the law of gravitation was not peculiar to the solar system. It told us the law extended to the distant shores of the abyss in which our island is situated. It gives us ground for believing that the law of gravitation is obeyed throughout the length, the breadth, the depth and the height of the entire visible universe.*

Thus we have learned that the binary stars are linked by invisible chains, though each star may be millions of miles distant from its companion star.

The New Star in Ophiuchus.—Sometimes a new star will blaze up suddenly and then gradually fade away. Such a case occurred in 1604, when a new star suddenly appeared in the constellation Ophiuchus. It was observed by Kepler, and remained visible for fully two years. Finally it disappeared so that it cannot now be identified.

* "The Story of the Heavens," p. 396 Sir R. S. Ball

Serpens, the Serpent

It is particularly interesting, because Kepler wrote a curious book about it, in reply to the argument of the philosophers of the day, who contended that the wonderful star was caused by the chance meeting of atoms. Kepler's reply was characteristic —

I will tell these disputants, my opponents, not my own opinion, but that of my wife Yesterday, when I was weary with writing, my mind being quite dusty with considering these atoms, I was called to supper, and a salad I had asked for was set before me "It seems, then," said I, aloud, "that if pewter dishes, leaves of lettuce, grains of salt, drops of water, vinegar and oil and slices of egg had been flying about in the air from all eternity, it might at last happen by chance that there would come a salad" "Yes," says my wife, "but not nice and well-dressed as this of mine is!"

(The position indicating where the new star appeared is shown on Chart X, an arrow pointing to the place on the edge of the Milky Way. In fact, new stars as a rule are usually seen in or near the Milky Way or Galaxy)

SERPENS, THE SERPENT

Vast as the starry Serpent, that on high
Tracks the clear ether, and divides the sky,
And southward winding from the Northern Main,
Shoots to remoter spheres its glittering train
(STATIUS)

Biblical critics imagine that this constellation is alluded to in the following passage of the

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Book of Job. "By His Spirit He hath garnished the heavens. His hand hath formed the crooked serpent"

Serpens is one of those straggling and sprawling constellations which seem at first so difficult to trace, yet with the assistance of Chart X a glance will enable one to find the Serpent's outline, the three stars Kappa, Gamma and Beta marking its head, and (μ) Mu the tip of its tail. The star Alpha, if looked at with a three-inch telescope, is seen to be a very wide and unequal double star, the smaller companion requiring a good deal of looking for, but the search is worth while on account of the pretty contrast in colour which they show. The larger star is pale yellow, its companion a soft tint of blue. Alpha was the *Cor Serpentis* or "Heart of the Serpent" of astrology, referred to by Ovid and Virgil. Those who own a three-inch telescope will find an account of the stars in this group on p. 103 of Captain Noble's book "Hours with a Three-inch Telescope."

SEVENTH EVENING

LIBRA, THE BALANCE, AND SCORPIO, THE SCORPION

. . . Now dreadful deeds
Might have ensued,

. . . had not soon
The Eternal, to prevent such horrid fray,
Hung forth in heaven his golden scales, yet seen
Betwixt Astræa and the Scorpion sign

Paradise Lost (Milton)

LIBRA, the Balance, is east of the zodiacal constellation Virgo, sharing the honour of being one of the selected groups of stars denoting the Sun's highway. As we have already seen, Virgo was the goddess of Justice, and Libra represented the scales, which she is usually represented as holding in her left hand, as an appropriate emblem of her office.

According to Virgil, the husbandmen of ancient times were wont to regard this sign as indicating the proper time for sowing their winter grain.

But when Astræa's balance, hung on high,
Betwixt the nights and days divides the sky,
Then yoke your oxen, sow your winter grain,
Till cold December comes with driving rain.

The Greeks considered that the balance was

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placed among the stars to perpetuate the memory of Mochus, the inventor of weights and measures.

Although this constellation has no bright conspicuous star, it may easily be traced by the

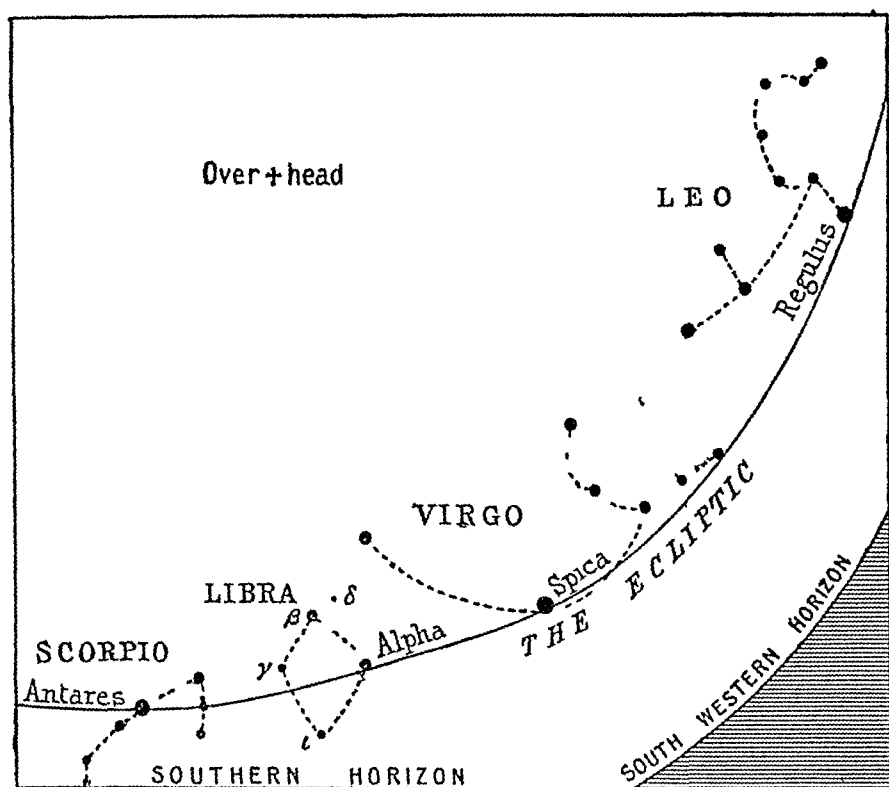


CHART XI.—ZODIACAL SIGNS. SCORPIO, LIBRA, VIRGO, AND LEO.

quadrangular group formed by Alpha, Beta, Gamma and Iota. (See Chart X.) Another method may be found by imagining a curved line drawn through Antares, in Scorpio, Alpha, in Libra; Spica, in Virgo; and Regulus, in Leo; all these stars lying along the Ecliptic or Sun's highway. (See Chart XI)

Objects of Interest in Libra.—Alpha is a double star, the components being of the third and

Libra, the Balance

fifth magnitude respectively, and their colours pale yellow and dove-grey. The companion star can easily be seen with an opera-glass. Beta is noticeable for its decided green colour, which is very unusual among conspicuous stars. According to the Rev. T. W. Webb, "deep green like deep blue is unknown to the naked eye." Delta is a remarkable variable star with a period of $2\frac{1}{3}$ days. The time occupied by the actual changes is about twelve hours, during which period it drops from the fifth to the sixth magnitude. (Magnitude always refers to brightness, not size. Thus, Alcturus is a first magnitude star, while a sixth magnitude is just on the limit of visibility with the unaided eye. An opera-glass is required to show a star of the seventh magnitude.) Delta belongs to what is known as the "Algol" type, stars whose light is periodically eclipsed by a dark companion star coming between us and the light of the bright component. About ninety variables of this class are now known, and new ones are continually found.

A Cluster of Stars.—On the extreme northern border of Libra is a cluster of stars known as Messier 5. (See Chart X.) It is remarkable for the number of variable stars it contains, of which eighty-five at least have been detected. So rapid are the changes taking place in their appearance as to be obvious on photographs taken two hours apart. The cluster when seen in a telescope

Evenings with the Stars

presents the appearance of a beautiful assemblage of stars closely compressed in the centre. Seen with a three-inch telescope, it looks like a nebula, very bright towards the centre. Admiral Smyth describes it as "a noble mass refreshing to the senses after searching for faint objects" From personal experience, and owing to the kindness of the late Professor Barnard, it was the writer's great privilege to see this cluster through the great 40-inch lens at the Yerkes Observatory. Myriads of glistening points shimmering over a soft background of starry mist, illumined as though by moonlight, formed a striking contrast to the darkness of the night-sky. For a few blissful moments, during which the watcher gazed on this scene, it suggested a veritable glimpse of the heavens beyond.

Not only is the cluster remarkable from its appearance when seen through a telescope of high power, but also on account of the revelations which have been made by means of photography, notably by Professor Bailey, when he was stationed at the Arequipa Observatory, Peru. On examination of the photographic plates taken of this region of the sky, it was found that at least forty-six, possibly sixty stars in the cluster, are variable.*

* In recent catalogues M5 is denoted by the prosaic record N G C. 5904, the initials standing for the "New General Catalogue," compiled by Dr Dreyer

Scorpio, the Scorpion

Are these sixty another instance of the effect produced by dark stars periodically eclipsing the light of their brighter companions in the cluster? Are the dark stars, cool, dark globes, like our planet, covered with luxuriant vegetation, and peopled with inhabitants basking in the heat and light of one or more of the clustered stars? One could let the imagination run riot as to the various probabilities regarding existence on such worlds, but there are no means of penetrating into the remote depths separating us from those distant orbs in space. They must doubtless remain for ever hidden to mortal eyes, just as our planet is to them, for even at the distance of the nearest star our planet Earth is absolutely invisible. We need have no fear of the prying eyes of our neighbours in space, for they are not even aware of our existence.

SCORPIO, THE SCORPION

In a wide circuit of the heavens he shines
And fills the place of two celestial signs

(OVID)

The Scorpion, the most brilliant of the zodiacal constellations, lies south-east of Libra, which in ancient times formed its claws. It is easily recognizable on account of its curving outline, and long, streaming tail extending far down to the south, though some are of the opinion that

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it resembles a boy's kite rather than a scorpion. In Australasian skies it is seen at its best, curving around the point overhead like a veritable snake, during the month of July.

In the northern hemisphere, we only see it as it lifts itself partly above the south-east, creeping along the southern horizon, and finally disappearing in the south-west. The moment its last star sinks from view, Orion rises in the east, the two constellations never being above the horizon at the same time. This recalls the Grecian legend, according to which the death of Orion was caused by the sting of a scorpion.

Antares, the Scorpion's Heart.—*Antares*, which marks its heart, is the brightest star in this constellation. It is accompanied by a companion star of a greenish hue, which forms a charming contrast to the ruddy tinge of the larger star. Unfortunately, the smaller star cannot be seen except with a powerful telescope.

The history of its discovery is somewhat as follows. Apparently, the star *Antares* had long been a source of perplexity to astronomers. That it was a brilliantly red star seen in our latitudes scintillating low down in the south during the summer months was a well-established fact, but when the star was watched intently, especially with an instrument of adequate power, a peculiar green light was found to force itself persistently into view. Suspicion was at last

Scorpio, the Scorpion

aroused among observers to the effect that the star must have a green companion which had so far escaped detection.

At length, Professor O. M. Mitchell, at that time Director of the Cincinnati Observatory, actually had a glimpse of the green star, and as this was the first noteworthy achievement of the Cincinnati telescope, the discovery was a source of considerable gratification. Then he heard the unwelcome news that another observer had seen Antares accompanied by *two* green stars. Nothing daunted, again and again Professor Mitchell searched for the second green star, but could find no trace of it, when, to his great delight, a message arrived, announcing that the telescope at the other observatory was to blame. It possessed the undesirable faculty of dividing small stars on its own—that is to say, it had a way of separating stars into couples when in reality they were single. Confidence restored as to the accuracy of his telescope, the professor turned it once more on Antares, and again the wily companion of verdant hue eluded capture. Then, intrigue was resorted to by the scientist, who brought into play an artificial device by means of which a star is hidden behind a small cross-bar of brass or copper introduced into the telescopic eyepiece for that purpose, and the star under observation is seen the instant it emerges before it becomes lost in the over-

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whelming rays of the larger star. But the former was too minute and nestled too closely to Antares to be trapped by any such subterfuge

However, it happens that Antares is one of the bright stars already referred to which lie along the Moon's path, and in front of which she occasionally passes in her journey along the Ecliptic. The noted observer Mr. Dawes, one of those keen-eyed astronomers whose sharp sight when using a telescope was phenomenal, laid another trap for the wily companion star. He knew an occultation of Antares by the Moon was about to take place, and he decided to watch carefully, so as to settle the vexed problem. Consequently, when the Moon had hidden Antares, Mr. Dawes had the intense satisfaction of seeing the small companion star shining alone for a few seconds in the telescopic field of view. There was no doubt about its colour, which proved to be unmistakably green; and its identity was now fully established.

It is interesting to consider the possibilities of the conditions existing upon a world travelling around such a system. "Imagination fails to conceive," says Sir John Herschel, "the charming contrasts and graceful vicissitudes of a red and green day, alternating with light or with darkness, in the planetary systems belonging to these suns."

So accustomed are we to the white light re-

Scorpio, the Scorpion

ceived from our own Sun, that were it suddenly to glow with a green or ruddy hue we should be overcome with amazement. Yet such would be the case if we were inhabitants on a planet belonging to the system of Antares. Imagine the two suns above the horizon, how strange would be the appearance of the sky on this distant world. "Often one sun must pass before the other, and then the colour of the day changes, passing through many gradations, as the strange transit of sun over sun is in progress. Then every object on such a planet must cast two different shadows. If the suns are red and green, for instance, the shadows are red and green. When we remember how large a part shadows play in the appearance of a landscape, we see at once how strange a scene the hills and dales, and villages and woods in those distant worlds must present to those who inhabit them *.

Objects of Interest in Scorpio.—Antares, so named by the Greeks because it rivals the ruddy hue of the planet Mars (Greek, *Ares*), is a pretty sight as seen with an opera-glass. A number of faint stars are scattered around it, as though dancing attendance on this magnificent orb. The brightness of Antares exceeds that of the Sun two thousand times, yet its distance from our planet is so vast that a ray of light, though travelling at a rate that would encircle the Earth

* "The Orbs Around Us," pp 320-321 R. A. Proctor

Evenings with the Stars

seven times in a second, would yet require one hundred and fifty-five years in crossing that vast abyss "Were its light to cease shining to-day," as R. J. Pocock suggests in his book, "The Constellations as seen in Southern India," "we should not know it till about A.D. 2066." Antares is attended not only by the green star already referred to, but by a very close companion which has never been seen, but of whose existence we have been made aware through the shifting lines in the spectrum of Antares. Thus its presence has been revealed to us by means of the spectroscope, in the same way as in the case of the unseen attendant of the star Spica, in Virgo.

As we have already noted, it is useless looking for the Scorpion overhead, but from the summit of a hill, or by the seashore where a clear, unobstructed view of the sky can be obtained, observations made of this constellation by means of an opera-glass or field-glass will prove very pleasing. A glance at Chart, XII, during the daytime will show where double stars and clusters are located, and the following facts connected therewith may prove of interest.

Beginning with the star Beta (near the top of the chart) an opera-glass turned in its direction will show that it is not only a double star, but that there are two small stars beneath it, like a pendant to the larger star (with which,

Scorpio, the Scorpion

however, they are not connected). The colours of the double star Beta are white and lilac. To the left of Beta is a star-cluster "80 M.," and a

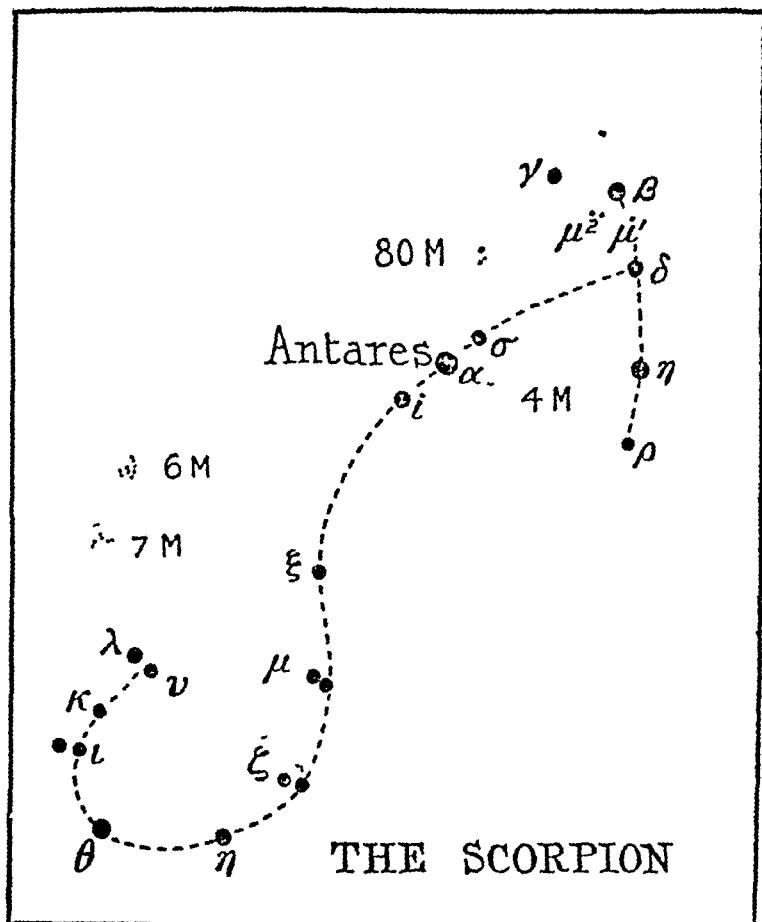


CHART XII—CONSTELLATION OF THE SCORPION
[ENLARGED SCALE]

Antares, a double star, red-green Clusters, 6 M, 7 M, 4 M, 80 M,
Double stars α , β , μ , ζ , ι

little lower down almost on a level with, and to the right of, Antares, is another cluster known as "4 M" When looked at with an opera-glass, or, better still, a field-glass, it presents the

Evenings with the Stars

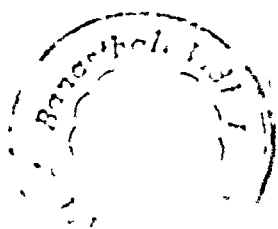
appearance of a central blaze of light. In 1783 Sir William Herschel turned his great ten-foot reflector in its direction, and saw the blaze resolve itself into a cluster of stars

The star X_1 (ξ) is a double star, having magnitudes of $4\frac{1}{2}$ and $7\frac{1}{2}$ respectively, and the colours of the components are white and grey. A fifth magnitude star lies close to the primary or larger star, so that X_1 is actually a triple star. Below X_1 is the star μ (μ), which the opera-glasses will separate into two stars, each one seemingly making an attempt to rival the other in brightness, a species of celestial twins. Zeta (ζ) consists of two stars, one a glowing red in contrast to the soft blue tint of its companion attendant.

To the eastward above λ (λ) there are two clusters of stars, "7 M" and "6 M." With an opera-glass, and on a clear night, it is possible to see some of the separate stars twinkling in the silvery haze which distinguishes these clusters from the stars near by. Both the clusters can be seen in the field of view of an opera-glass at the same time, producing a striking effect. The star cluster known as "80 M" was discovered by Sir William Herschel in 1781, and described by him as "the richest and most condensed mass of stars which the firmament offers to the contemplation of astronomers." On May 21st, 1860, Auwers, a

Scorpio, the Scorpion

noted observer, saw a star of magnitude 6.5 in the cluster which had not been noticed there before, but by the middle of June of that same year it had vanished and has not been seen again. It is suspected that it may be a variable star, such as blaze out from time to time, and concerning which we shall hear more later, or the blaze-up seen by Auwers may have been the last expiring gleam of a star on the verge of extinction.



EIGHTH EVENING

LYRA, THE HARP , CYGNUS, THE SWAN , AQUILA,
THE EAGLE , DELPHINUS, THE DOLPHIN

THE above constellations have been selected for observation during the month of August, as they are conveniently situated nearly overhead, and well above the southern horizon. At such a time it would seem well to act on the advice already suggested, that an ideal way for observing the stars is to select some place from which a clear, unobstructed view of the sky can be obtained. Spread out a rug on the ground, with a comfortable cushion to support the head, and in absolute comfort enjoy star-gazing at leisure.

On any of the dates indicated on Chart XIII, two bright stars seen exactly overhead are the eyes (Beta and Gamma) of the Dragon, with which we have already become acquainted. They seem to be glaring at the bright star Vega to the left, thus serving indirectly as a guide to the constellation Lyra, the Harp, of which it is the leading brilliant. We have already seen how a line produced through Alpha and Gamma in the Great Bear serves the same useful purpose.

Lyra, the Harp

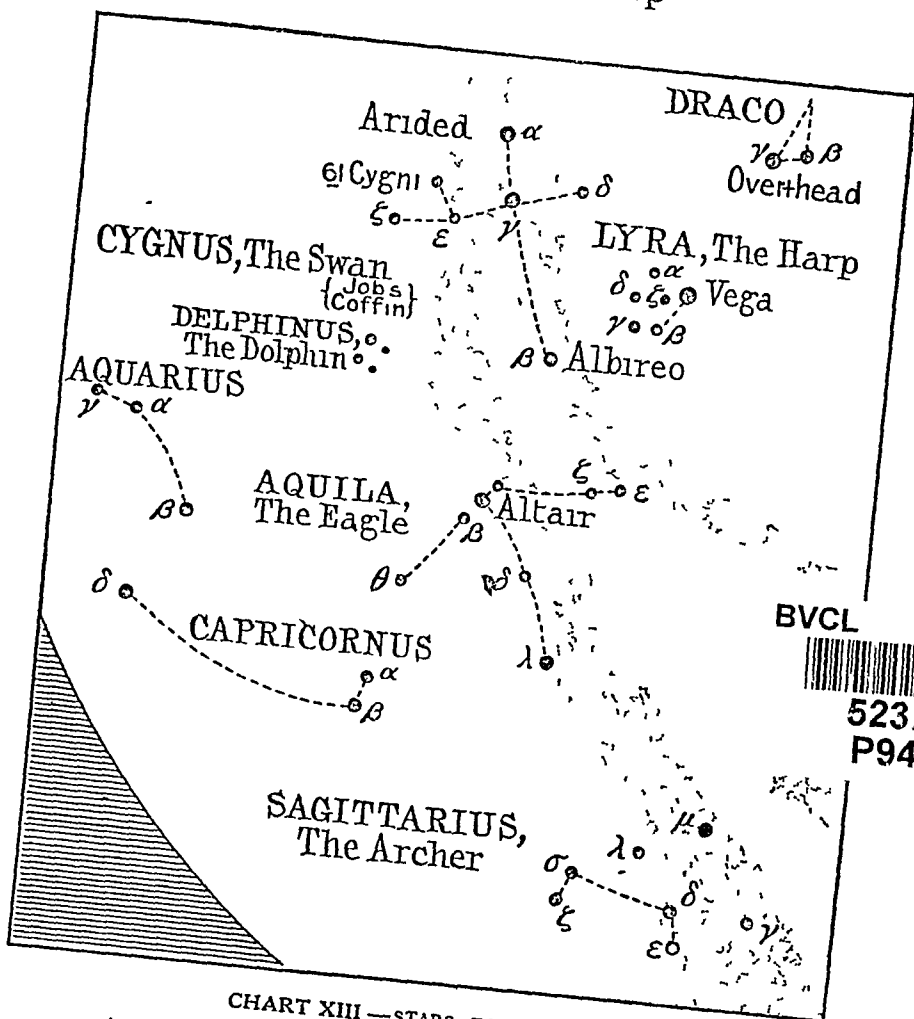


CHART XIII — STARS FOR AUGUST

August 3, 9 15 pm
August 7, 90 pm
August 11, 8 45 pm

August 15, 8 30 pm
August 19, 8 15 pm
August 23, 8 0 pm

LYRA, THE HARP

In olden maps this constellation has the outline of a harp, and according to Grecian legend it was the celestial lyre with which Orpheus charmed the wild beasts of the forest. In the

Data Entered

Evenings with the Stars

poem by Longfellow entitled *The Occultation of Orion*, he refers to it in the following lines —

I saw with its celestial keys,
Its chords of air, its frets of fire,
The Samian's great Æolian lyre
Rising through all its sevenfold bars
From earth into the fixed stars

Virgil thus describes the effect of the lyre when Orpheus sought the domain of Pluto, in search of his lost bride, Eurydice —

E'en to the dark dominions of the night
He took his way, through forests void of light,
And dared amid the trembling ghosts to sing,
And stood before the inexorable king
The infernal troops like passing shadows glide
And, listening, crowd the sweet musician's side

.

The gaping three-mouth'd dog forgets to snarl,
The Furies hearken, and their snakes uncurl,
Ixion seems no more his pain to feel,
But leans attentive on his standing wheel
All dangers past, at length the lonely bride
In safety goes with her melodious guide

Alas for the sequel! which resulted in her swift return when Orpheus backward gazed. After a disastrous end he received divine honours and with his lyre became one of the constellations

According to Aratus, Lyra was the Little Tortoise or Shell, thus going back to the legendary origin of the instrument from the empty covering of the creature cast upon the shore with the

Lyra, the Harp

dried tendons stretched across it. Lowell thus describes its discovery and use by Hermes —

So there it lay though wet and dry,
As empty as the last new sonnet,
Till by and by came Mercury,
And, having mused upon it
“Why, here,” cried he, “the thing of things
In shape, material and dimension !
Give it but strings, and lo ! it sings—
A wonderful invention ”

For the Arabs, Lyra is the swooping “Stone Eagle of the Desert,” which shows the bird with half-closed wings, in contrast to “the Flying Eagle,” our constellation Aquila, and the outspread wings of Cygnus, the Swan described by Eudokia as—

The graceful form, amid the lucid stream
Of the fair Milky Way

The constellation Lyra is on the western edge of the Milky Way and next to Hercules, with which constellation we became acquainted on the sixth evening of our ramble in Starland. In fact, all four of the groups of stars to be observed this evening are near that constellation.

Objects of Interest in Lyra.—Vega is a splendid star of the first magnitude, its delicate blue tinge intensified when seen with the assistance of an opera-glass

In an ordinary telescope it appears as a single star, but with a large object-glass two distant small companion

Evenings with the Stars

stars are seen A nine-inch glass shows also two small companions within a few seconds of Vega. In the great Harvard refractor Vega is seen with no less than thirty-five companions I imagine that all these stars, and others which can be seen in the neighbouring fields, indicate the association of Vega with the neighbouring stream of the Milky Way *

It has been the writer's privilege to see the star Vega through the great refractor at Yerkes Observatory. Its vivid blue blazes and the twirlings of the diffraction rings which surround the great star made it appear a marvel of beauty, recalling the description of the star by Manilius, who wrote in the age of Augustus .

*One, placed in front above the rest, displays
A vigorous light and darts surprising rays*

Aratus describes it as illuminating

*The heavens far around, blazing imperial
In the first order*

The main interest, in connexion with Vega, is the fact that it is the star towards which the solar system is drifting An indelible impression was made on my mind when I heard an address given by Professor Simon Newcomb at the dedication of the Flower Observatory, University of Pennsylvania, May 12th, 1897. He referred to this journey as follows —

I have seldom felt a more delicious sense of repose than when crossing the ocean, during the summer months, I sought a place where I could lie alone on deck, look up

* "Half-hours with the Telescope," p 48 R A Proctor

Lyra, the Harp

at the constellations, with Lyra near the zenith, and, while listening to the clank of the engine, try to calculate the hundreds of millions of years which would be required by our ship to reach the star α Lyræ, if she could continue her course in that direction without ever stopping. It is a striking example of how easily we may fail to realize our knowledge, when I say that I have thought many a time how deliciously one might pass those hundred millions of years in a journey to the star α Lyræ, without its occurring to me that we are actually making that very journey at a speed compared with which the motion of a steamship is slow indeed.

Through every year, every hour, every minute of human history from the first appearance of man on the earth, from the era of the builders of the Pyramids, through the period of every event history records, not merely our earth, but the sun and the whole solar system with it, have been speeding their way towards the star of which I speak, on a journey of which we know neither the beginning nor the end. We are at this moment thousands of miles nearer to Alpha Lyræ than we were a few minutes ago when I began this discourse, and through every future moment, for untold thousands of years to come, the earth and all there is on it will be nearer to Alpha Lyræ, or nearer to the place where that star now is, by hundreds of miles for every minute of time come and gone. When shall we get there? Probably in less than a million years, perhaps in half a million. We cannot tell exactly, but yet there we must arrive if the laws of nature and the laws of motion continue as they are. To attain to the stars was the seemingly vain wish of an ancient philosopher, but the whole human race is, to a certain extent, realizing this wish as fast as a speed of twelve miles a second can bring it about.

According to Dr Crommelin, "The sun's speed

Evenings with the Stars

would carry it, in 75,000 years, over a space equal to the distance of the nearest star. In the direction towards which the sun is moving there is no star so near to us as Alpha Centauri, Vega being seven times as remote as this, it is, however, likely that a million years will suffice for the sun to pass some of the stars towards which he is winging his way, and leave them on the other side. There need be no apprehension of a very near approach with another star, for such encounters must be extremely rare." *

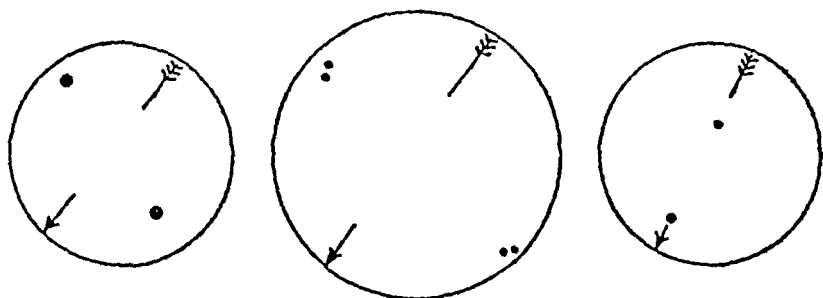
To the left of Vega is the star Epsilon (ϵ), which can be seen as a double star with the unaided eye (if the observer has good eyesight), and better still with an opera-glass. A powerful telescope shows that each of the stars forming the double is itself a double, so that it is a double-double, or what might be termed a foursome. Moreover, there are three faint stars between ϵ^1 and ϵ^2 , possibly forming with the quadruple a single system. Their reply to a query as to their number should then resemble that of the heroine of Wordsworth's poem, *We are Seven*; providing the three faint stars actually form part of the system.

Several times Sir William Herschel saw Epsilon as a double, and the noted German astronomer Bessel affirms that when he was a lad of thirteen he could see it thus. Persons having

* "The Star World," p 178 A C Crommelin.

Lyra, the Harp

average eyesight could see it double by selecting a suitable date and hour for observation, such as those suggested on Chart XIII Chart XIV gives an idea of the appearance of this star when seen with a small telescope



Zeta Lyrae ϵ^1 and ϵ^2 Lyrae Eta Lyrae

CHART XIV—THE APPEARANCE OF DOUBLE STARS SEEN WITH A SMALL TELESCOPE

Zeta (ζ) is a double star, both nearly equal in brightness, their colours being topaz and green The star Delta (δ) is orange and blue Turn next to the stars Beta (β) and Gamma (γ), chiefly remarkable on account of the variability of their light It is interesting to watch these stars for a few nights in succession, and note their change in brightness On some evenings the stars are of equal brightness, on others Beta will be fainter by perhaps an entire magnitude This star seems to consist of two bodies which revolve round each other, so near together as to be almost in contact. They are of unequal size and both are self-luminous The smaller object is much brighter than the larger. Some-

Evenings with the Stars

times the larger one passes in front of the smaller and hides its light, or the smaller one is in front of the larger, thus increasing its apparent brilliancy. Another time the smaller one hides behind the other, and then, in consequence, we can only see the light of the larger one, which is not so bright. These changes take place with pendulum-like variety, and resemble when plotted out what has been termed the saddle-back curve shown in Chart XV. The variations run through a regular period of nearly thirteen days, during which time the star first reaches a maximum of 3.4 magnitude, then sinks to the

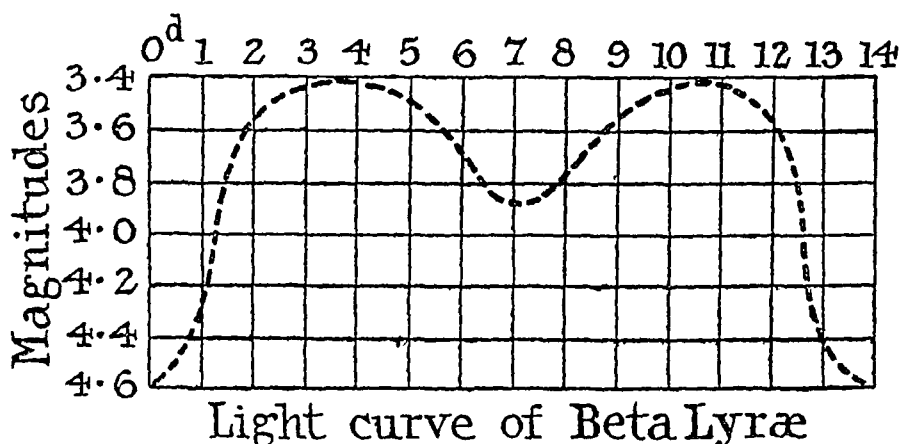


CHART XV —SADDLE-BACK CURVE DETECTED BY GOODRICKE IN 1784, AND COMPLETELY TRACED BY ARGELANDER IN 1844

3.9 magnitude, next rises to the 3.4 magnitude, and finally sinks to the 4.5 magnitude. The changes were first detected by Goodricke in 1784, and completely traced out by Argelander in 1844. In a letter written by John Goodricke,

Lyra, the Harp

June 27, 1785, he describes the discovery of the variability of Beta Lyrae, as follows —

On the 10th of September, 1784, whilst my attention was directed towards that part of the heavens where β Lyrae was situated, I was surprised to find this star much less bright than usual, whereupon I suspected that it might be a variable star, my suspicions were afterwards confirmed by a series of observations, which have been regularly continued since that time At first I thought the light of this star subject to a periodical variation of nearly six days and nine hours, though the degree of its diminution did not then appear to be constant but now, upon a more close examination of the observations themselves, I am inclined to think that the extent of its variation is twelve days and nineteen hours

Thus we find that anyone who is interested in observing the stars gradually becomes so familiar with their appearance that he can quickly detect whether the light of one particular star increases or diminishes Goodricke, who was an adept in this work, was born in Groningen, Netherlands, in 1764. His father was English, and later returned to England and settled in York

Goodricke was a deaf-mute, but, in spite of his infirmity, he received a good education in classics and mathematics In a small building in the garden behind his friend Pigott's house, the two carried on together their astronomical observations At eighteen he had discovered the period and the law of the variation of Algol, and suggested that it was due to an eclipse He

Evenings with the Stars

also discovered the variability of β Lyræ and δ Cephei, and gave their periods. He died at the early age of twenty-two *

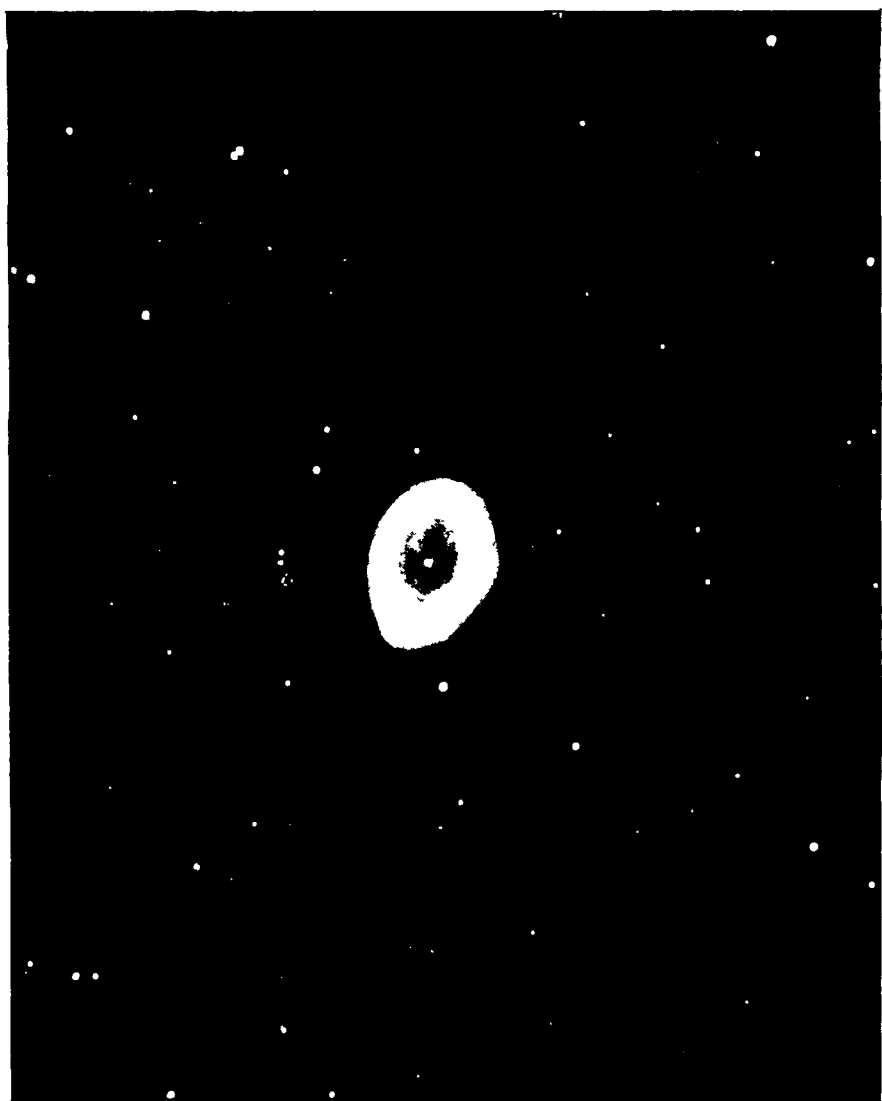
The Ring Nebula.—Nearly midway between Gamma and Beta lies the wonderful ring nebula, “57 M,” which presents the appearance of a ring of hazy light when observed with a small telescope, but with a larger one faint nebulous matter “like gauze stretched over a hoop” can be seen within the ring. The giant refractor at the Lick Observatory reveals the presence of a star in the centre of the ring, which has been confirmed by the photographs taken of this marvellous object, known by the name of the “Ring Nebula.” In the centre of the ring is a star which seems to have special actinic power, as it is more conspicuous on the photographs than visually.

CYGNUS, THE SWAN

Thee, silver Swan, who, silent, can o’erpass?
A hundred with seven radiant stars compose
Thy graceful form amid the lucid stream
Of the fair Milky Way (EUDOSIA, b iv)

The constellation of Cygnus, the Swan, is situated in the Milky Way, as the above quotation implies. In old maps it is represented as a swan with outspread wings, flying down the Milky Way towards the south-west. The constellation is sometimes referred to as “the

* “The Observatory,” Vol. xxv., 271, 368



RING NEBULA IN LYRA

Photographed at Dominion Astrophysical Observatory, Victoria, British
Columbia with the 72-inch reflector

Cygnus, the Swan

Northern Cross," the upright piece reaching from the star Alpha (α) to Beta (β), and the cross-piece from Delta (δ) to Epsilon (ϵ). It lies immersed in one of the richest regions of the Milky Way, but between the stars Alpha (α), Gamma (γ), and Epsilon (ϵ) is a dark rift resembling the "Coal-Sack," a sort of hole seen in the region of the Southern Cross in southern skies.

According to Ovid, this constellation took its name from Cygnus, a relative of Phaeton, while others say it is Orpheus who was changed into a Swan, and placed near his beloved Harp (Lyra) in the sky.

Objects of Interest in Cygnus.—Alpha (α), or Deneb as it was called by the Arabians, is a star of the first magnitude, its colour is white, and it is the brightest star in the constellation. It has a companion star of the 12th magnitude, which cannot be seen except by means of a powerful telescope. Beta (β), or Albireo, is one of the finest coloured double stars in the sky when seen with a telescope. "The components are sharply contrasted in colour, the larger being golden-yellow, while the smaller one is a deep, rich blue. With a field-glass of 16 inch aperture and magnifying seven times, I have sometimes been able to divide this pair, and to recognize the blue colour of the smaller star. It will be found a severe test for such a glass. About half-way from Albireo to the stars

Evenings with the Stars

ζ and ε in Aquila is a very curious little group consisting of six or seven stars in a straight row, with a garland of other stars hanging from the centre. To see it best, take a field-glass, although an opera-glass shows it " *"

Above and to the left of Epsilon (ε) is a small star marked 61 Cygni, and of special interest because it is the nearest star in the northern skies, and with two exceptions (Proxima and Alpha Centauri) is the nearest in all the heavens. Nevertheless, so great is its distance that its light requires ten years to reach the shores of our planet. Therefore, we do not see it as it is now, but as it was ten years ago, so that for us it is but a record of the past. It is easily found by completing the parallelogram of which Alpha, Gamma, and Epsilon are the three corners. It is not remarkable for its size or brightness, since it is barely visible to the unaided eye; nevertheless, it is the first star which enabled us to "overcome the great and hitherto impassable barrier to our excursion into the sidereal universe," to quote the words of Sir John Herschel in his address delivered before the Royal Astronomical Society. The occasion was the presentation of the Gold Medal to Bessel, in 1840, in appreciation of his success in overthrowing this barrier.

The star 61 Cygni is an interesting example

* "Astronomy with an Opera-glass," pp. 55-56 G P Serviss

Cygnus, the Swan

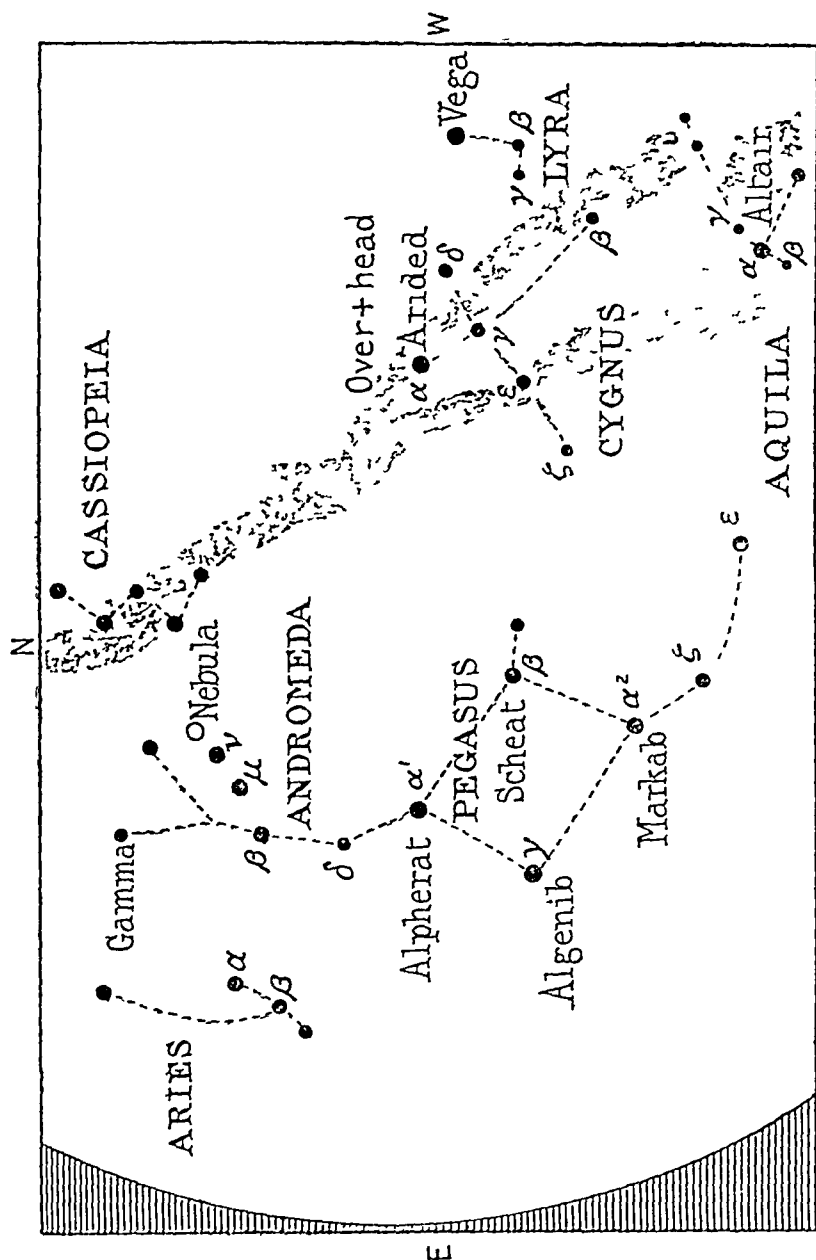


CHART XVI—STARS FOR AUGUST AND SEPTEMBER

August 23, 100 p m	September 4, 915 p m	September 15, 830 p m
August 27, 945 p m	September 8, 90 p m	September 19, 815 p m
August 31, 930 p m	September 12, 845 p m	September 23, 80 p m

Evenings with 'the Stars

of a double star, the two being connected by a bond of mutual attraction, and they are carried together over the sky at a rate of thirty miles a second. "In a million years," according to Sir Robert Ball, "61 Cygni will apparently have moved through a distance which is twenty-five times as great as its present distance from the Sun. Whatever be the direction in which 61 Cygni is moving—whether it be towards the Earth or from the Earth, to the right or to the left—it must have been about twenty-five times as far off a million years ago as it is at present, but even at its present distance 61 Cygni is a small star, were it ten times as far it could only be seen with a good telescope; were it twenty-five times as far it could barely be a visible point in our greatest telescopes" *

The star 61 Cygni, like all the stars in the sky, seems to move slowly on account of its enormous distance from the shores of our planet, yet its motion is a thousand times faster than that of the swiftest steamer that ever ploughed the main. It may be compared with the appearance of a steamer seen on the distant horizon by an observer watching it from the seashore. The steamer seems to be absolutely motionless, yet looking at it again an hour or so later a perceptible change is noticeable in its position. In fact, the observer knows that were he stand-

* "The Story of the Heavens," p 421 Sir Robert S. Ball

Aquila, the Eagle

ing on the deck of the steamer no doubt could exist in his mind as to the fact that it was rapidly forging ahead at the rate of many miles an hour. It is only when seen from a distance that it appears comparatively motionless. It is distance that causes the illusion, which on a grander scale may be said to apply to the motion of the stars.

AQUILA, THE EAGLE

The tow'ring Eagle next doth boldly soar,
As if the thunder in his claws he bore,
He's worthy Jove, since he, a bird, supplies
The heaven with sacred bolts, and arms the skies
(MANILIUS)

According to the Grecian legend, this is the eagle that Jupiter kept beside his throne. It is supposed to have been Merops, a king of the island of Cos, in the Grecian Archipelago, who was transformed into an eagle and placed among the constellations.

The Eagle is a group of stars immersed in the Milky Way, and is easily distinguished by its leading brilliant Altair, or Alpha (α) Aquilæ.

Objects of Interest in Aquila.—Altair is a brilliant star of the first magnitude, and is taken as the *standard* first-magnitude star. Several of those which are ordinarily called first magnitude, like Sirius and Vega, are very much brighter than this, while others fall considerably below it, so that it makes what might be termed the

Evenings with the Stars

average in brilliancy. Its colour is yellow, and it has a companion star of the tenth magnitude, of violet hue. In the great refractor at the Yerkes Observatory, Professor Burnham saw over a dozen faint stars near the larger star.

On either side of Altair are the stars Beta and Gamma, apparently acting as escorts, while a number of fainter stars, easily discernible with a powerful field-glass, also form part of the stellar retinue. The star Eta in Aquila needs watching, for it is a variable star, nearly doubling in brightness during the course of a single week, these changes taking place with the utmost regularity.

DELPHINUS, THE DOLPHIN

The constellation of the Dolphin lies 15° east of Altair, and is mainly distinguished by four stars, arranged diamond-shaped, and popularly known as "Job's Coffin." These stars are faint, but can be seen clearly on a fine night. *Gamma*, at the north-west corner of the diamond, is a pretty double star, the colours gold and bluish-green. *Alpha* is a double star, pale yellow and pale lilac.

Alpha and *Beta* are distinguished by the names Snalocin and Rotanev, which seemed passing strange, and concerning them one authority suggested that they put "derivation and etymology at defiance."

Delphinus, the Dolphin

In "Celestial Objects for Common Telescopes," by the Rev T W. Webb, we find on pages 106 and 107 the following simple and ingenious explanation —

Where so eminent and accomplished a scholar and antiquarian did not succeed [referring to El Battani, Ibn Tunis and other authorities], it would seem presumptuous to offer a solution, but that accident is sometimes more fortunate than study, and if the following is not after all the right key, it certainly is a marvel that it should open the lock so readily. The letters of these strange words reversed form Nicolans Venator, a Latin version of the name of Niccolo Cacciatore, assistant at the Palermo Observatory, in the catalogue from which these stars are so denominated

Legend of the Dolphin.—According to Grecian mythology, this constellation represents the Dolphin on whose back the famous musician Arion rode through the sea, after escaping from the sailors who tried to murder him.

Spenser pays the following tribute to the friendly dolphins —

Then was there heard a most celestial sound
Of dainty music which did next ensue,
And, on the floating water as enthroned,
Arion with his harp unto him drew
The ears and hearts of all that goodly crew
Even when as yet the dolphin which him bore
Through the Ægean seas from pirates' view,
Stood still by him, astonished at his lore
And all the raging seas for joy forgot to roar

NINTH EVENING

PEGASUS, THE WINGED STEED , ANDROMEDA, THE
CHAINED LADY ; AND ARIES, THE RAM

With only half his body rolls the sacred steed,
He, as they say, from lofty Helicon
Brought the flashing water of wholesome Hippocrene
No streams gushed from the top of Helicon
Till the steed pawed then gurgling they out-welled,
Where his fore-foot stamped and shepherd swains
First named that drink the fountain of the Horse
(ARATUS)

OVID claims Mount Helicon as the home of Pegasus, the Winged Steed . only a part of the horse is shown on old star maps, so that this group of stars has sometimes been referred to as "the Half Horse," or as "the Steed of mighty Nimrod." According to Greek mythology, this is the celebrated horse that sprang from the blood of Medusa, which dropped into the ocean after Perseus had severed her head . Pegasus became the favourite of the Muses, and was given to Bellerophon, son of Glaucus, King of Ephyre, to aid him in conquering the Chimera, a hideous monster with three heads which exhaled flames . After the destruction of the monster, Bellerophon attempted to fly up to the sky upon Pegasus, but Jupiter was so annoyed at his presumption

Pegasus, the Winged Steed

that he sent an insect to sting the horse, which reared and threw its rider. Bellerophon fell to earth, and Pegasus continued its flight up to the sky, where it was placed by Jupiter among the stars.—

Now heav'n his further wand'ring flight confines,
Where, splendid with his num'rous stars, he shines
(OVID)

The "great Square of Pegasus," as it is usually called, is a conspicuous group of four stars, and is easily found by a line from Vega, in the Harp, through Gamma—the middle star of the cross-bar of the Northern Cross or the Swan—continued as far as Beta (β) in the Square. On any of the dates given on Chart XVI, it can be found covering a wide range of sky, midway between the point overhead and the eastern horizon.

Although Pegasus presents such an imposing appearance in a part of the sky singularly devoid of bright stars, and covering a region so vast that it is six weeks in passing the meridian—viz. from the first of October to the tenth of November—yet there are few objects of special interest within the Square. Nevertheless, an opera-glass will bring into view many small stars whose light is too faint to reveal their presence to the unaided eye.

Objects of Interest in Pegasus.—The Square of Pegasus as marked in star maps is apt to be

Evenings with the Stars

confusing Sometimes we find two Alphas, Beta, and Gamma, the Alphas being Alpha¹ and Alpha² respectively Others mark the Square, Alpha, Beta, Gamma and Delta, the last star being one of the Alphas, and notably the star that serves the double purpose of belonging both to Pegasus and Andromeda. Old star maps show the head of the Chained Lady gracefully reposing on the shoulder of the horse The Alpha that marks her head is Alpha in Andromeda, which is also the Alpha¹ that glows in the constellation Pegasus This star thus doubly owned is undoubtedly confusing at first, especially as this identical Alpha is the star sometimes lettered Delta, which does not improve matters Fortunately, each star has an Arabian name, by which it can be recognized, and these are the names given on Chart XVI. They are as follows —Alpha¹ or Alpherat, Alpha² or Markab, Beta or Scheat, and Gamma or Algenib

Markab (Alpha²) is one of the nine conspicuous stars lying along the Moon's path (as we have already seen) that are used for determining longitude at sea It is a white star and of the second magnitude Algenib (Gamma) and Alpherat (Alpha¹) are stars of great importance, as indicated on Chart XVII With the star Beta in the constellation Cassiopeia, they are situated on the prime meridian, and point out its direction through the pole. They

Pegasus, the Winged Steed

are sometimes referred to as *the three girdles*, and form an arc of that great circle in the heavens from which the distances of the heavenly bodies are measured

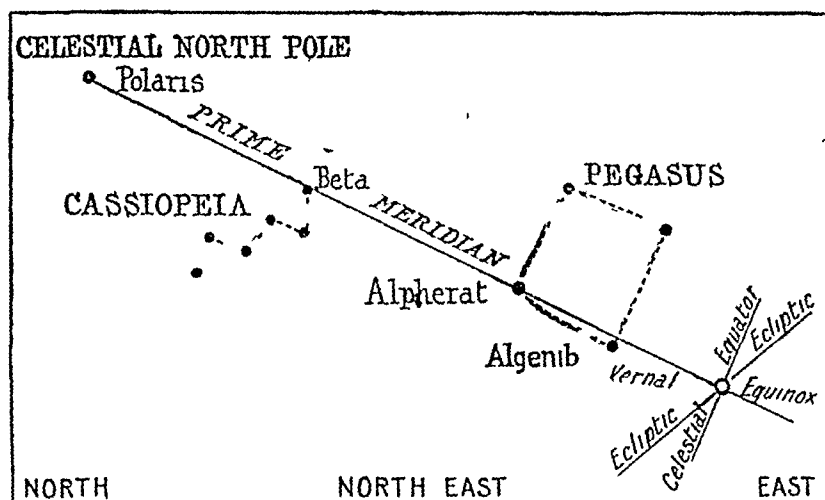


CHART XVII — THE GREENWICH OF THE SKY

A line drawn through *Polaris*, the Pole-star, *Beta*, in *Cassiopeia*, *Alpherat*, in *Pegasus*—prolonged 30° further south—locates the *Vernal Equinox*

This circle passes through the poles, and the Equinoxes at Aries and Libra, and is in astronomy what the meridian of Greenwich is in geography, for which reason it is sometimes termed "the Greenwich of the sky" Twenty-two centuries ago, in the days of Hipparchus, the constellation of Aries, the Ram, occupied the first *sign* in the ecliptic, commencing at the vernal equinox, but in consequence of the annual precession of the stars, the constellation of the Fishes now occupies that *sign* Thus, Aries the constellation is now in the *sign* Taurus,

Evenings with the Stars

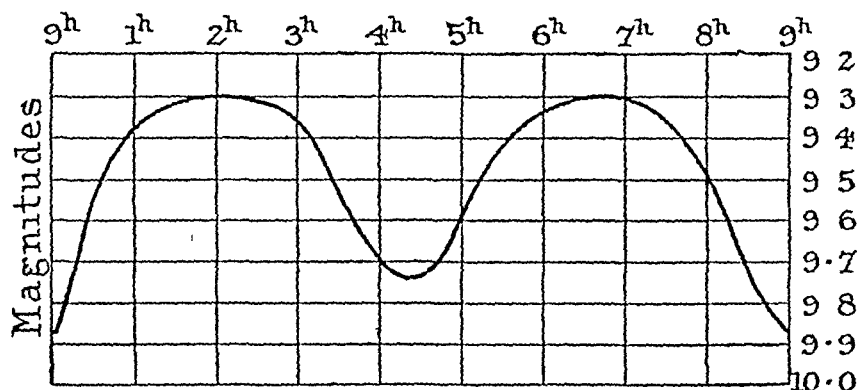
Taurus is in that of Gemini, Gemini is in Cancer, and so on.

[The star Epsilon (ϵ), which in old star maps marks the tip of the Horse's nose, has a blue companion of the eighth magnitude, the larger star being of an orange hue. When near the meridian, the small star as seen in the field of view of a telescope appears underneath the larger one. A curious experiment described by Sir John Herschel may be tried with this star, and from personal experience it proves to be vastly entertaining. Swing the tube of the telescope slightly from side to side, and the small star will appear to describe a pendulum-like movement with regard to the larger one. This may be due to the longer time required for a fainter light (such as that of the small star) to affect the retina of the eye, so that the reversal of motion is first perceived in the larger star.]

In a direct line between Beta (Scheat) and Epsilon (ϵ) and within a few degrees of the former, is the star U Pegasi, which has proved so perplexing to astronomers with its period of only a few hours. The variation in light is of the saddle-back variety, shown in connexion with Beta Lyrae, and the changes suggest that the two bodies which form the visible star may be in actual contact with each other. Its complete period is 8 hours, 59 minutes, 41 seconds, or 19 seconds less than 9 hours, and during that

Pegasus, the Winged Steed

period (as shown in Chart XVIII) its light brightens, grows dim, and repeats the process, which suggests the probability that the periodic time is below $4\frac{1}{2}$ hours, the shortest yet known. U Pegasi is sometimes referred to as "the Winking Star," or, as a German astronomer denotes



Light curve of U Pegasi - The Winking Star
- of the Beta Lyræ type

CHART XVIII

these variables, it is a "Blink-Stern," which conveys practically the same idea. The normal state of such variable stars is faint, then, suddenly; they brighten like one awakening from sleep and rise rapidly in a short time to their full brightness, ultimately sinking to invisibility. The rapid brightening and gradual decline may be compared to the effect produced by a revolving light in a lighthouse on the sea-coast, and the changes are always performed with the same absolute regularity. There is an undoubted fascination in watching variable stars, which prove an endless source of entertainment to the

Evenings with the Stars

owner of a small telescope and an accurate star atlas wherein they are mapped. Professor H N Russell, a leading authority on the subject, remarks that: "If we really understood the causes of stellar variation, we should probably have advanced a long way towards the solution of the whole problem of stellar evolution, if not have solved it completely."

ANDROMEDA, THE CHAINED LADY

We now come to Andromeda, which next to Orion is one of the most interesting groups of stars visible in northern skies. It is closely linked to Pegasus, since, as already stated, a star marking the shoulder of the Horse also indicates the head of the Chained Lady. As we have already seen, the designers of the quaint old star maps made the same star serve a double purpose, and incidentally it is a help in locating the constellation of Andromeda. The two constellations thus linked have always seemed easy of recognition to the writer, for the reason that they appear to resemble, on a large scale, the outline of the Plough. The four stars in the Square of Pegasus are duplicates of the four in the Plough, though much farther apart, and the three stars Delta (δ), Beta (β) and Gamma (γ) in Andromeda correspond to the three horses. Two stars to the right of Beta, all three situated in a row and called Mu and Nu, form the girdle



NEBULA IN ANDROMEDA
Photographed at the Yerkes Observatory

Andromeda, the Chained Lady

of Andromeda. Just beyond Nu at the north-western extremity of the girdle is a remarkable nebula, and the only one of its kind visible to the naked eye. This is the famous *Nebula in Andromeda*, which needs a whole section to itself.

The Great Nebula in Andromeda.—The Great Nebula in Andromeda, the Queen of Nebulæ, was mentioned as far back as A.D. 906 by the Persian astronomer Al Sufi, who described it as the “Little Cloud” It is plainly visible to the unaided eye, and has frequently been mistaken for a comet With a good field-glass, in clear weather and the absence of the Moon, the nebula is a very attractive sight A faint, wispy light extending lengthwise on either side of the nucleus is clearly discernible, as well as several faint stars in its neighbourhood Seen through a telescope of high power, it presents the appearance of a concealed light shining through horn or semi-transparent glass, according to the description given by Simon Marius, who, in the tenth century, was the first to turn a telescope in its direction The soft, hazy light of the nebula gradually brightens towards the centre, where it condenses into a nucleus of indistinct outline Photographs reveal endless detail and dark rifts, and a sprinkling of innumerable minute stars which are apparently between us and the nebula.

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Near the nucleus, though it may not have had any actual connexion therewith, a new star suddenly made its appearance in August, 1885. A photograph taken by Dr. Common, the year before, of that same region of the nebula gave positive assurance that in August, 1884, its place had no stellar occupant as bright as the fifteenth magnitude. What were virtually the first rays of light from the new star arrived on August 17, 1885.

The conflagration must have occurred long before the message, speeding on the wings of light, finally arrived at the shores of our planet and imprinted itself on the photographic plate. It was not the type of new star which suddenly blazes out with a splendour comparable with that of the brighter stars, for at no time did it exceed the range of six and one-half magnitudes, consequently, it was beyond reach of the unaided eye. Moreover, its sudden access of temporary splendour was brief, for in about six months it had passed beyond the range of any existing telescope. The decline in brightness was at first gradual, then a pause like the fitful gleam of an expiring ember, and finally its light became so dim that even the largest telescopes failed to keep the new star in view after March, 1886.

What its story was, before and after its advent, can only be inferred from the possibilities of such a catastrophe occurring in space.

Andromeda, the Chained Lady

From what we know of star-drift it may have actually plunged into the nebulous mass surrounding the nucleus of the Andromeda nebula as it rushed onward through space, or as Miss A. M. Clerke suggests in her book entitled "The System of the Stars"—

The outbreak of the new star has shown that the action of the powers engaged in moulding it to its predestined shape may occasionally be attended by a liberation of energy causing a cataclysm

There are no more interesting objects in the sky than new stars, for they appear unheralded, and to the amateur who has become thoroughly acquainted with the positions of the leading brilliants in the sky, the sudden appearance of a new star in their midst cannot fail to attract attention. One of the peculiarities of new stars is that they have all been found in or near the Milky Way. Therefore, it is as well to make the acquaintance of the groups of stars which are outlined against it or border along its banks, so that one may have the pleasure some night of detecting an intruder.

Gamma in Andromeda.—Another picturesque object in Andromeda is the star Gamma (*see* Chart XVI). It is one of the most interesting double stars which can be observed with very moderate telescopic power. The magnitudes of the stars are 3 and $5\frac{1}{2}$ respectively, and the colours are orange and green. In imagination one sees

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a world illumined by this double sun system. Let us suppose the world circling round a sun of a rich orange colour, while a companion sun of a green colour travels round the same sun on a path resembling that of the planet Jupiter, both suns circling round their common centre of gravity. The green sun would be a brilliant orb, it is true, but far surpassed in splendour by the orange sun, which would not only be larger but also nearer than the smaller green sun. The orange sun illumines one side of the supposed world, and the green sun the other, so that there can be no night, since it is orange day to one-half of the world and green day to the other. At the time of sunset, the orange sun would be nearing the west and the green sun appearing over the eastern horizon. Then would come an orange sunset and a green day, but the green sun would set before the orange sun rose, and there would be therefore a short night illumined faintly by the blue twilight in the west and orange twilight in the east.

By degrees the length of this night would increase, the orange and green hours gradually shortening, until at length the green sun would have drawn quite near to the place of the orange sun in the heavens, and there would be double day and night, but neither orange day nor green day alone. After this the green sun would pass to the west of the orange sun, and would be

Andromeda, the Chained Lady

placed like Jupiter when he is a morning star. There would then be green morning, white day (caused by the blending light of the green and orange colours of the two suns, which are complementary), orange evening and night, the night gradually growing shorter and shorter, until at length the green sun would be opposite the orange sun, and there would be no night, but simple alternation of green day and orange day, as at first ¹

Radiant Point of Meteors.—The star Gamma is of interest not only on account of its being one of the most beautiful coloured double stars and a triple star as well, since powerful telescopes show the smaller component as also double, but because it serves to indicate the radiant point of the meteoric fragments of a once remarkable comet

Its name was Biela, for it was discovered by Wilhelm von Biela, an Austrian officer, at Josephstadt in Bohemia, on February 27, 1826. Its story is brief and dramatic, and condensed is as follows —It was found to be revolving in an orbit of short period, so that its next return was fixed for November 27, 1832, when it re-appeared with great punctuality. Its return, however, had been awaited with mixed feelings, for while it was an event of no special importance

* "The Expanse of Heaven" Chapter on Worlds Lit by Coloured Suns, pp 229-237 By R A Proctor

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in the astronomical world, it caused a genuine cometary "scare" among those who were unaware of scientific terms.

According to an announcement made by a great astronomer named Arago, a considerable portion of the comet's train would actually sweep over the spot which, a month later, would be occupied by our planet. It needed no more to start a panic, as the alarmed public feared that an actual collision between the comet and our planet might occur, supposing the astronomers had by some trifling oversight erred in their calculations. Nor did the panic subside until Arago formally demonstrated that the earth and comet could by no possibility approach within less than fifty millions of miles. The comet came and went, and all was well, but before its return, in 1845-46, something had occurred which was most extraordinary. When first seen it wore its usual aspect of a faint round hazy-looking patch, a month later it had become pear-shaped, and finally split in two. The pair were watched with amazement, the twin comets travelling side by side, though separated by an interval of more than 150,000 miles. The interval had widened to 1,250,000 miles by 1852, and since that time the comet has been irretrievably lost. According to Sir John Herschel, who conjectured that it might have come to grief in its passage through the labyrinth of

Andromeda, the Chained Lady

meteor systems in the heavens, "peradventure it has plunged into and got bewildered among the rings of meteorolites." This was written in 1866, when astronomers had searched for the comet with the utmost care but without success.

The climax of the story was reached on the evening of November 27, 1872, when in Italy and other countries where the atmosphere was clear an unusual spectacle was witnessed, surpassing the display in England on that same occasion, when some forty or fifty thousand "shooting-stars" were observed falling between the hours of five and eleven. In Italy at the height of the display the smaller meteors were so numerous that the appearance presented was that of a cloud of light, the glistening fragments apparently of the lost comet.

But this was not the last chapter in the chequered career of Biela's comet. According to a telegram sent by Professor Klinkerfues at Berlin to Pogson at Madras, a piece of the comet had fallen on our planet. The following is the historic message sent on that occasion: "Biela touched Earth November 27. Search near Theta Centauri." Owing to a cloudy sky during the thirty-six hours following the receipt of the telegram, Pogson was unable to make any telescopic observations. However, when the clouds parted, there was the comet in the place indicated by the astronomer at Berlin. The next

Evenings with the Stars

night it was seen again, but that was its final appearance

A meteorite, known as the "Mazapil meteorite," was for a while a suspected fragment of the comet, and a ranchman's statement of it, as it appeared at Mazapil in Mexico, is as follows

It was at about 9 o'clock on the night of November 27th, when I went out to the corral to feed certain horses, suddenly I heard a loud sizzling noise, exactly as though something red-hot was being plunged into hot water, and almost instantly there followed a somewhat loud thud. At once the corral was covered with a phosphorescent light, while suspended in the air were small luminous sparks, as though from a rocket. A number of people came running towards me, and when we had recovered from our fright we saw the light disappear, and bringing lanterns to look for the cause found a hole in the ground, and in it a ball of light. We retired to a distance, fearing it would explode and harm us. Looking up to the sky, we saw from time to time exhalations of stars, which soon went out without noise. We returned after a little, and found in the hole a hot stone which we could hardly handle, this, on the next day, we saw looked like a piece of iron. All night it rained stars, but we saw none fall to the ground, as they all seemed to be extinguished while yet very high up *

This, according to Mr Denning, the well-known authority on meteors,

is the first observed instance in which a meteorite has actually reached the Earth's surface during the progress of a star-shower. If its identity with the meteors of Biela's Comet is admitted, then all classes of meteoric

* *Century Magazine*, vol xxxiv, p 534 W E Hidden

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phenomena would appear to have a community of origin *

In 1885 another great meteoric shower occurred near the radiant point Gamma in Andromeda. In fact, every year on November 27, when the Earth crosses the path where the comet once drifted, meteoric fragments may be encountered, for which it is as well to be on the look out, in case once more a fragment may fall to Earth

. . . a sudden trail of fire,
Attracting with involuntary heed
The eye to follow it, erewhile it rest,
And seems some star that shifted place in heaven
(DANTE)

Legend of Andromeda.—According to the mythology of the Greeks, Andromeda was the daughter of Cepheus and Cassiopeia. The latter imprudently boasted that her daughter was more beautiful than the Nereids, who appealed to their god Neptune to avenge the insult. A sea-monster was sent to destroy Andromeda, who was chained to a rock. Hence her name of "The Chained Lady." Just as the monster was approaching the fair maiden, Perseus, who was returning through the air from a conquest of the Gorgons, rescued her from her impending fate by turning the monster into stone through the petrifying influence of the Gorgon's head which he still held in his hand.

* "Telescopic Work for Starlight Evenings," pp 270-271 W F Denning

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ARIES, THE RAM

Aries is now the second constellation in the Zodiac, having resigned its position as first in order, which it occupied twenty-two centuries ago, to Pisces, the Fishes. It is, as already stated, enriched by the star *Arietis*, one of the nine conspicuous stars lying along the Moon's path, used by nautical men for determining their longitude at sea. The star *Arietis* is nearly on the same meridian with *Almaach* (*Gamma* the double star) in the foot of *Andromeda* and culminates only four minutes later. Therefore it should be easy to locate this star in the sky. A glance at Chart XVI will show that Aries is a rather inconspicuous group of stars, but distinguished by *Hamal* or *Arietis* (*Alpha*) of the second magnitude, and *Sheratan* (*Beta*) of the third, and its fainter neighbour, *Mesartim*.

These stars are in the head of the Ram, which according to fable was the object of the great Argonautic expedition for the recovery of its golden fleece. It carried *Phryxus* and his sister *Helle* through the air, when they fled to *Colchis* from the persecution of their mother *Ino*. The rapid motion of the ram in its aerial flight above the earth caused *Helle* to turn faint from giddiness, and she fell from its back into that part of the sea now named after her as the *Hellespont*, in memory of the dread event. *Phryxus* arrived safely at

Aries, the Ram

Colchis, but was murdered by Ætes, who envied him his golden treasure. This gave rise to the celebrated Argonautic expedition under the command of Jason, for the recovery of the Golden Fleece.

According to Ptolemy, the ship *Argo*, which led the expedition, was named after a son of Jason. It was said to have been the first ship that ever ventured on the sea. When Jason returned in triumph, he ordered the ship to be drawn ashore at the Isthmus of Corinth and consecrated to Neptune, the god of the sea.

TENTH EVENING

SAGITTARIUS, THE ARCHER ; *CAPRICORNUS*, THE GOAT, *AQUARIUS*, THE WATER-BEARER ; AND *PISCES*, THE FISHES

DURING the month of September our ramble in Starland takes us southward, along the Sun's highway, where we make the acquaintance of the three zodiacal constellations Sagittarius, Capricornus, and Aquarius. As Sagittarius covers a large space in the sky, and is remarkable for a group of five stars, usually referred to as "the Milk Dipper," it is particularly easy to find. The handle and the edge of the Dipper are in the Milky Way, and the three stars Altair, Delta (δ), and Gamma (γ) in the constellation of the Eagle point directly to the star Mu (μ), which adorns the tip of the handle. This figure has also been called "the Ladle," "the Tiger," and "the Hobby Horse of Sagittarius," and it has been found outlined on ancient Babylonian monuments. The early zodiacs of Egypt and India show it as the arrow which, according to Greek mythology, was aimed by Sagittarius at the heart of the Scorpion near by. In the mythology of Greece the constellation is said to commemo-

Sagittarius, the Archer

rate the famous Centaur, Chiron, who changed himself into a horse to evade the jealous inquiries of his wife Rhea. He was famous for his knowledge of music, medicine, and shooting. He taught Apollo music, and Hercules astronomy, but the latter proved an ungrateful pupil, for, according to Ovid, to avenge an insult to his bride the Centaur was slain by Hercules with an arrow dipped in the blood of the Hydra. Chiron was afterwards placed by Jupiter among the stars, where :

Midst golden stars he stands refulgent now,
And thrusts the scorpion with his bended bow.

The Milky Way in Sagittarius.—Sagittarius passes through one of the richest regions of the Milky Way, which is seen at its best in southern skies. The writer well remembers the splendour of the display in the clear skies of Australasia. There one can realize the meaning of Milton's "broad and ample road whose dust is gold," and Sir John Herschel, who described his view of it as resembling stars seemingly "flung down by handfuls, with both hands at once."

This, the brightest part of the Milky Way, glowing with a luminous radiance as if it were shining through a transparent veil, is to be found near the star Gamma (γ), which in olden maps marks the tip of the arrow. (See Chart XIX.) A cluster of stars known as "Messier 8" is a

Evenings with the Stars

bright spot in the section of the Milky Way in Sagittarius, and it is plainly visible to the unaided eye. A little to the north-west of this cluster is the famous Trifid Nebula, which, as its name implies, is a perforated star-cloud with three dark rifts as though a celestial breeze had wafted them apart. Nebulæ and clusters have interwoven themselves amid outlying stars, like tendrils clinging around a vine. (Messier 8 and the Trifid Nebula in Sagittarius are west of Gamma, and therefore beyond the region included in Chart XIX.)

In the month of August, 1889, Professor Barnard, at that time a member of the staff of the Lick Observatory, was the first to obtain a successful photograph of the marvellous structure of the Milky Way. The instrument with which the work was accomplished was, to quote his own words, "an old portrait lens, which had done service in a San Francisco photograph gallery picturing the vanities of humanity. This lens, which was made in 1859 by Willard of New York, was 6 inches in diameter and 31 inches focus, and though small and insignificant compared with the regular photographic telescope, was specially suited for photographing the Milky Way and similar objects. Owing to its short focus it took in a large area of the sky, and compressed or crowded the clustering stars, and thus intensifying both their light and peculiarities of



TRIFID NEBULA IN SAGITTARIUS

Photographed at Mount Wilson Observatory with the Hooker Telescope, or
100-inch reflector



Sagittarius, the Archer

arrangement in cloud forms, made it possible to photograph them." *

The photograph shows two black spots, one of which is as sharply defined as if someone had drawn its outline with a brush and black paint. According to Professor Barnard, this is seemingly a vacant region through which we look out into space beyond, and not a dark mass coming between us and the stars cutting off their light. This is proved beyond doubt by the presence in the hole of a conspicuous star with a small attendant preceding, and one or two fainter stars in the background like spectators watching the progress of Royalty

According to Sir William Herschel, these black holes like yawning abysses amid the starry regions of the Galaxy denote the ravages of time, and are among the most important of celestial phenomena. Since the days of Herschel we have become more familiar with the peculiarities of these vacant regions in the star-depths, although they are still more or less of a mystery. As we shall see later on, in considering a dark mass in the constellation Orion, some of these dark patches in the sky are undoubtedly due to opaque matter between us and the stars, though it is hard to believe in the existence of such matter on the tremendous scale shown by the photographs

* *The Photographic Times*, U S A , August, 1895

Evenings with the Stars

CAPRICORNUS, THE GOAT

Pitiless

Siroccos lash the main, when Capricorn
Lodges the sun, and Zeus sends bitter cold
To numb the frozen sailors. (ARATUS)

If a line be drawn from Vega through Altair, and produced about 23° farther, it will point to the head of Capricorn, and pass close to the stars Alpha (α) and Beta (β) in that constellation. It comes to the meridian about September 18, and with the three stars including Delta (δ) is easily recognizable. (*See Chart XIX.*)

From time immemorial this group of stars has been termed the Goat, or the Sea Goat. According to Greek mythology, Capricornus was said to be Bacchus, who with some other deities was feasting one day near the banks of the Nile. Suddenly the dread giant Typhon came upon them, and compelled them to assume a different shape in order to escape his fury. Ovid relates

How Typhon, from the conquer'd skies, pursued
Their routed godheads to the seven-mouth'd flood,
Forced every god (his fury to escape)
Some beastly form to take, or earthly shape
Jove (sings the bard) was chang'd into a ram,
From whence the horns of Lybian Ammon came,
Bacchus a goat, Apollo was a crow

According to another Greek legend, Capricornus represents Pan, who, on one occasion, in a frolicsome mood jumped into the Nile and

Capricornus, the Goat

transformed himself into a quaint-looking monster shaped like a fish below the water, and goat-like above. Zeus was so amazed at the transformation that he had it perpetuated among the stars, whence the origin of the ancient pictures of Capricornus as a goat with the tail of a fish.

By the followers of Plato this group of stars was called "the Gate of the Gods," through which the souls of men ascended to the sky when death released them from their earthly bondage. Among the Orientals it was "the Southern Gate of the Sun," and the Latin poets called it—among other names—"the Rain-bringing One," since it was thought to be a harbinger of storms and ruler of the waters.

Then grievous blasts
Break southward on the sea, when coincide
The Goat and the sun

In the astronomy of the Egyptians this sign was connected with Knum, the God of the Waters, associated with the rising of the Nile, and worshipped in Elephantine at the Cataracts. The divinity is represented as adorned with goat's horns.

The title Tropic of Capricorn, originating from the fact that when first observed the point of the winter solstice was located here, now refers to the sign and not to the constellation, this solstice at present being 33° to the westward, in the starry outline of Sagittarius, near its star μ (See Chart XIX, the star at the tip of the handle

Evenings with the Stars

of the Ladle.) From January 18 to February 14 the Sun is in Capricornus, when, as Dante wrote in the *Paradiso*

The horn of the celestial goat doth touch the Sun

Telescopic Objects of Interest.—The stars Alpha (α), called Giedi, and Beta (β), called Dabih, are double stars, and can be seen as such with the unaided eye if the sight is keen. When observed with an opera-glass, they are thrown well apart, and present a very pretty spectacle. The telescope reveals several faint companions, and Sir John Herschel suggested that they might be actual planets shining with reflected light, but it is more likely that they are faint stars shining with their own light. Alpha and Beta are so close to each other that they seem to form one system, yet they are actually drifting in opposite directions. Delta is a star of peculiar interest, as within five degrees eastward is the point where the new planet Neptune was found, according to the predictions made in 1846 by John Couch Adams of Cambridge University and Urban Leverrier of France.

AQUARIUS, THE WATER-BEARER

Under the Horse's head
The Water-Bearer, next to Capricorn,
Stretches his right hand (ARATUS)

This group of stars was probably so named because the Sun passed through it during the

Aquarius, the Water-Bearer

rainy season. On ancient Babylonian stones it was represented by the figure of a man pouring water into a bucket, and according to the Egyptians the setting of Aquarius caused the rising of the Nile, as he sank his huge urn in the river to fill it with water. The symbol for Aquarius, two undulating lines, is the hieroglyph for water.

In Grecian mythology Aquarius was Gany-mede, the cup-bearer of the gods. In old star maps he is represented holding a cup in his hands, tilted in such a way that water is continually pouring therefrom into the mouth of the Southern Fish (*Piscis Australis*) directly south of it, and easily found by means of its "one large and bright star" Fomalhaut (pronounced Fom-al-o) Fomalhaut is one of the four Royal Stars of astrology, supposed to govern the cardinal points of the heavens. The other stars are Regulus, Antares, and Aldebaran, concerning which we shall have information in the following chapter.

Objects of Interest in Aquarius.—Aquarius is chiefly of interest on account of its being one of the zodiacal constellations and for its richness in double stars, clusters, and nebulae. Its brightest star Alpha, or Sadalmelik—its Arabian name, which means "The Lucky One of the Kingdom"—is one degree south of the celestial equator. It is a double star, the larger one of the third magnitude is of a pale yellowish hue,

Evenings with the Stars

and the smaller companion of the eleventh magnitude is grey. From a point between Alpha (α) and Eta (η) radiate the Aquarids or meteors visible from April 29 to May 2. The radiants are only visible for a short time before sunrise. These are called the Eta Aquarids to distinguish them from the Delta Aquarids, which have a special display of their own, July 26-30, a fact not known until discovered in 1878 by means of the observations of W. F. Denning, our well-known authority on meteors. Delta is a star of the third magnitude, and its Arabian name is Scheat, meaning a wish, from the word *Al Shi'at* found for it on Arabic globes.

Beta, a yellow star of the third magnitude, is also known by the Arabian name of Sadalsund, which means "Luckiest of the Lucky," from its rising with the Sun, when the winter has passed and the season of gentle continuous rain has begun. On the Euphrates Beta was known as "The Star of Mighty Destiny," which may have suggested the name of *Fortuna Fortunarum* given to it by astrologers.

Gamma, a green star of the fourth magnitude, was known by an Arabian name which interpreted means "The Lucky Star of Hidden Things," because when it emerged from the Sun's rays all hidden worms and reptiles, buried during the cold of the winter months, crept out of their holes! It also means a tent or tents,

Piscis Australis, the Southern Fish

and the star was so called from its rising in the spring twilight, when, after the winter's want and suffering, the nomads' tents were raised on the freshening pastures, and the pleasant weather set in

The sun his locks beneath Aquarius tempers,
And now the nights draw near to half the day,
What time the hoar frost copies on the ground
The outward semblance of her sister white,
But little lasts the temper of her pen.

(Longfellow's trans of Dante's *Inferno*)

PISCIS AUSTRALIS, THE SOUTHERN FISH

This group of stars is connected in a way with that of Aquarius, and, as a glance at Chart XIX will show, is situated directly south of that constellation. Dante refers to it as the "Golden Fish," and it was the sky symbol of the god Dagon of the Syrians. According to the mythology of the Greeks, it was the form assumed by Venus when she fled at the approach of the monster Typhon.

Its one bright star, Fomalhaut, gleams lonely in the southern region of the sky during the autumn, and it is the farthest south of all the first-magnitude stars visible in our hemisphere. It is of a reddish hue, and shines without a rival in that part of the heavens. The origin of the name seems difficult to trace, but according to Mr. W. T. Lynn "The first mention I can find of it is in the Alfonsine Tables, where (as Ideler

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remarks) it is erroneously spelt Fomalhant It is there placed amongst the stars of Aquarius, who, as we have already seen, is represented as pouring a stream of water into the mouth of the fish. Whence Alfonso obtained the name of Fomalhant, or its more correct equivalent, Fomalhaut, I do not know. That the word is compounded of two Arabic words, and signifies 'the mouth of the fish,' there is no doubt "

This star is directly south of Delta (δ) or Scheat in Aquarius, and may be seen passing the meridian low down in the southern hemisphere on the 22nd and 23rd of October. It is one of the nine nautical stars lying along the Moon's path which can be used for determining longitude at sea. This consists in finding with a sextant the angular distance between some star whose position is well known and the Moon when passing near it, also the altitude of each at the same instant. These data furnish the elements of a spherical triangle, the solution of which, after various intricate corrections, results in determining the longitude of the given place.

In the early legends the Southern Fish was related to the Northern and Western Fishes that make up the constellation of the Zodiac known as Pisces, the Fishes A glance at Chart XIX will show that the idea of relationship between Pisces and Fomalhaut is rather far-fetched.

Pisces, the Fishes

PISCES, THE FISHES

Westward and southward in the south-wind's path
The Fishes float one ever uppermost
First hears the boisterous coming of the north
Both are tied by a band
Round their tails, which point to an angle
Filled by a single goodly star,
Called the Conjoiner of the Fishes' tails
(ARATUS)

This constellation is now the Leader of the Zodiac, and is usually represented by two fishes tied a considerable distance apart, at the ends of a long ribbon. It occupies a large triangular space in the sky, the Northern Fish being directly south of Beta in Andromeda, and the Western Fish to the south of the Great Square of Pegasus. At the bend of the ribbon (*see* Chart XIX) is the star Alpha (α) of the third magnitude, the Arabian name for which is *Al Ritscha*, meaning The Knot.

The Greeks somehow duplicated the legend of Venus and Typhon, as here we find the two fishes are supposed to commemorate the same event, adding that Venus was accompanied by her son Cupid, who likewise was turned into a fish on the occasion of the memorable encounter with Typhon. In accordance with this myth, the constellation was popularly known as "Venus and Cupid." The Western Fish is represented

Evenings with the Stars

by a lozenge-shaped figure of small stars, which is sometimes called "the Circlet."

Al Risha, or Alpha, the principal star in the constellation, is a double star, pale green and blue, the components being respectively of the

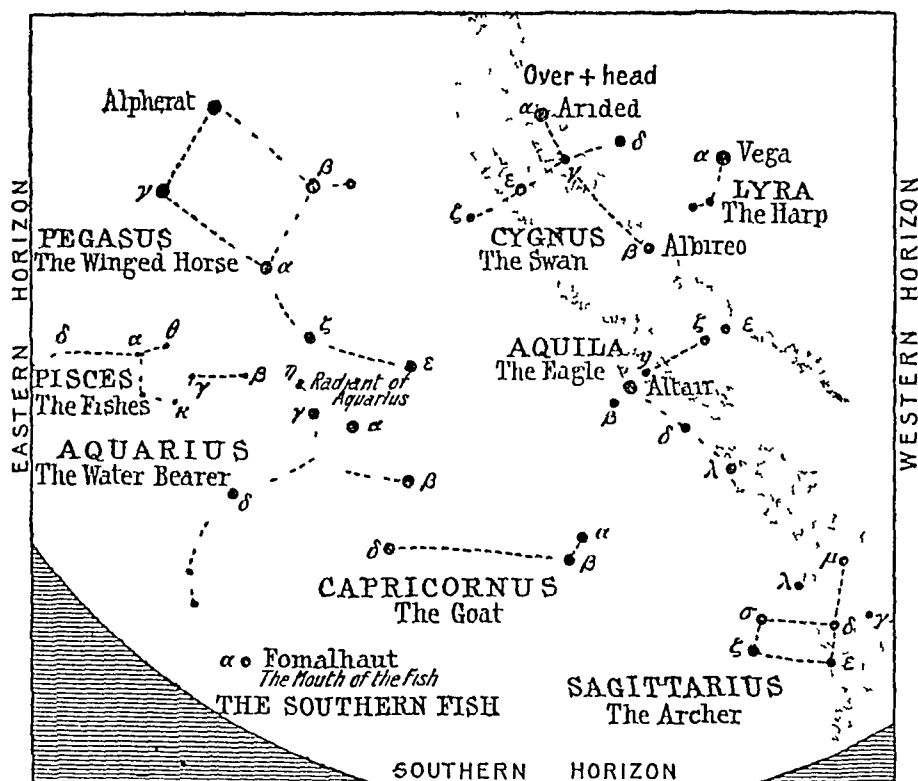


CHART XIX — STARS FOR AUGUST AND SEPTEMBER

August 23, 100 p m	September 4, 9 15 p m	September 15, 8 30 p m
August 27, 9 45 p m	September 8, 9 0 p m	September 19, 8 15 p m
August 31, 9 30 p m	September 12, 8 45 p m	September 23, 8 0 p m

fourth and fifth magnitude. It culminates on December 7. When there is no moon, the stars which indicate the ribbons uniting the Fishes can easily be traced in the sky, and they are seen to form a V-shaped cleft diverging from the so-called "Knot Star." A glance at Chart

Pisces, the Fishes

XIX will show that the Great Square of Pegasus is about to fall therein, or has emerged therefrom, as fancy suggests. Personally, it always gave the impression that Pegasus made his exit through this cleft, especially as only the head and shoulders were visible on old star maps, the rest of the outline of the horse being hidden from view. By this simple suggestion the discovery of the straggling group of stars known as the Fishes became an easy matter, and their close association with Pegasus a valuable aid in finding them. Heretofore, the Fishes had proved as elusive as the famous "Pimpernel" of fiction fame.

ELEVENTH EVENING

AURIGA, THE CHARIOTEER, CEPHEUS AND CASSIOPEIA; PERSEUS, THE RESCUER, AND CETUS, THE WHALE

BEFORE we start on our ramble in Starland this evening, let us retrace our steps, as it were, by glancing at Chart III. Thereon, the seven stars of the Plough, in *Ursa Major*, are shown in the position they occupy during the early evening in the month of April. Compare this with Chart XX, and we find that the Plough has swung half-way round, and during October and November is to be found on the northern horizon at this same hour. Its position overhead early in the evening has now been usurped by the W-shaped group of stars known as Cassiopeia —

Not numerous nor double-rowed
The gems that deck her form,
But like a key which through an inward-fastened
Folding-door men thrust to knock aside the bolts,
They shine in single zigzag row

On the right of Cassiopeia is Cepheus her husband, and southward her daughter Andromeda, at a safe distance from the sea monster Cetus. On her left is gallant Perseus who saved her from a terrible fate. Above Perseus is the

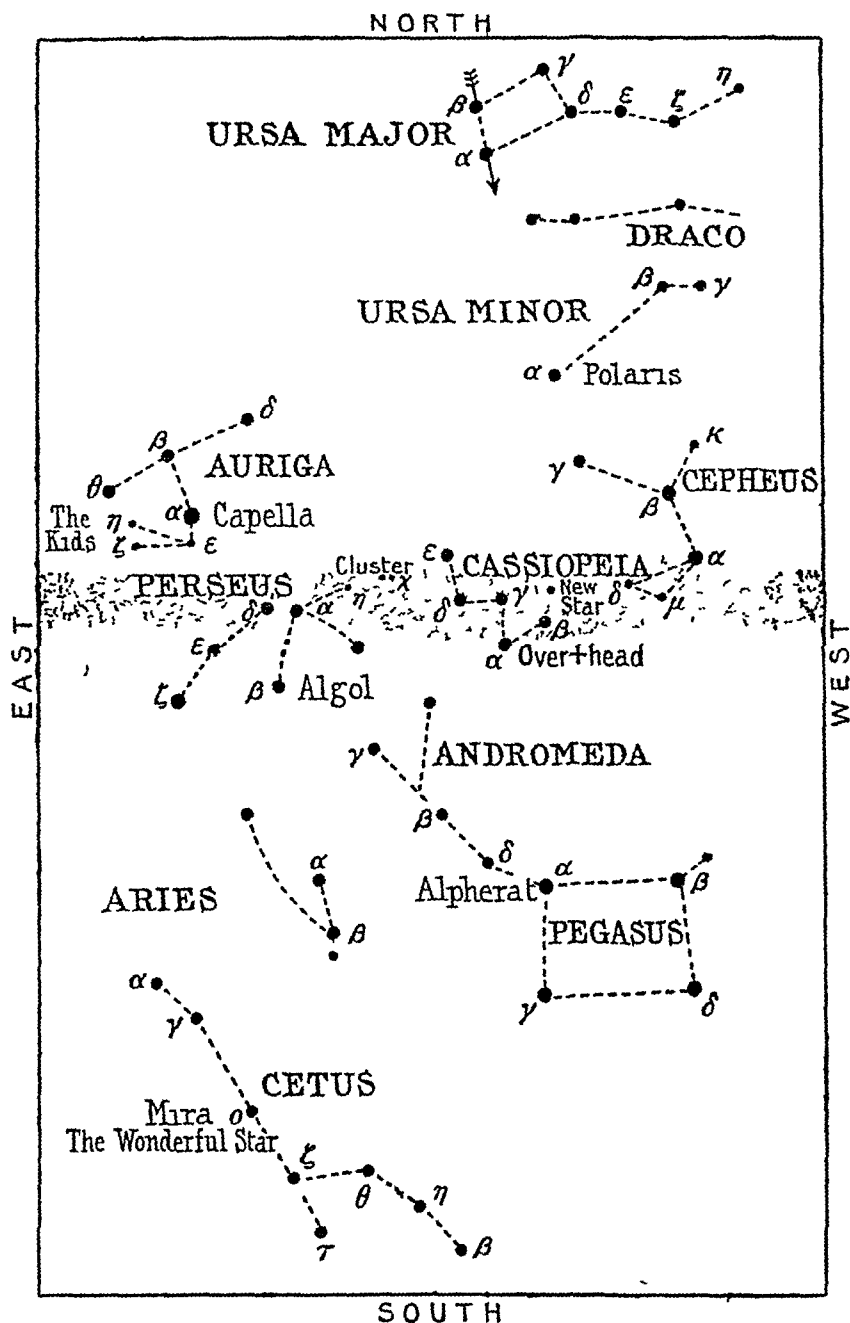


CHART XX — STARS FOR OCTOBER AND NOVEMBER

October 23, at 10 0 p m

October 26, at 9 45 p m

October 30, at 9 30 p m

November 3, at 9 15 p m

November 7, at 90 p m

November 10, at 8 45 p m

Evenings with the Stars

constellation of Auriga, the Charioteer, represented in olden maps holding two kids in his arms, and with a goat hanging upon his left shoulder. The stars representing the Goat and Kids were always regarded by astrologers as having a kindly influence with regard to sailors. According to Aratus —

If thou wouldst gaze on starry Charioteer
And hast heard legends of the wondrous Goat,
The Goat and Kids, that on the purpling deep
Oft look to rescue foundering mariners,
Vast looming shalt thou find him on the Twins' left,
His form bowed forward, Helce's* high head
Points at him from afar on his left shoulder
Lies the sacred She-goat, storied to have suckled Zeus,
And near to their bright mother with faint rays
Glisten the two kids o'er the giant's wrist

The stars Zeta (ζ) and Eta (η) are the Kids, as shown in old maps, and Alpha (α), or Capella, represents the Goat. Beta (β) is on the right shoulder of the Charioteer, and Capella on the left. After locating the stars Alpha (α) and Beta (β) in Auriga (see Chart XXI), and Beta (β) in Taurus, note how they form a slender triangle. Now glance at the stars Alpha (α) in Taurus and Orion, and it will be seen that they complete with the triangle a long, narrow parallelogram, whose length is just five times its breadth. The arrangement of the five stars

* Helce, another name for Calisto, who was changed into the Great Bear, *Ursa Major*, a line through Delta (δ) and Alpha (α) of *Ursa Major* points to Capella, the brightest star in Auriga.

Auriga, the Charioteer

bears a resemblance to a gigantic hour-glass. These outlines are helpful in locating the con-

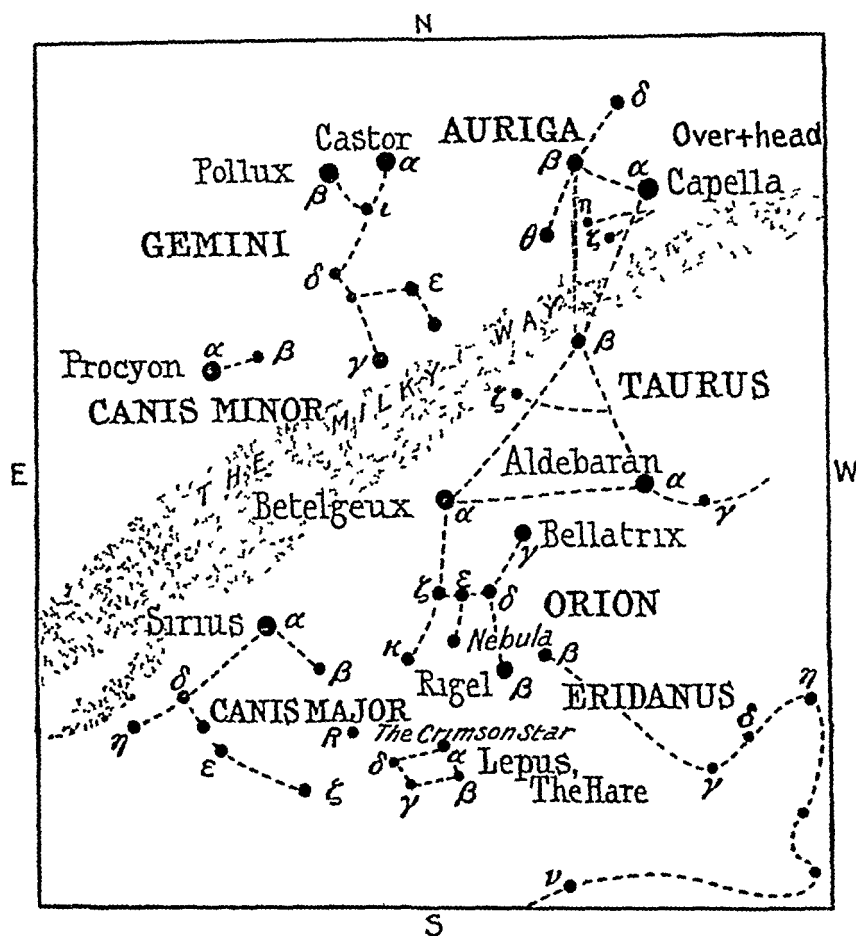


CHART XXI—STARS FOR DECEMBER AND JANUARY.

December 21, 10 0 p m
December 24, 9 45 p m.
December 28, 9 30 p m

January 12, 8 30 p m
January 16, 8 15 p m
January 20, 8 0 p m

stellations of Auriga, Taurus, and Orion, concerning which we shall hear more later. Moreover, the stars Delta (δ) in the head, Beta (β) in the right shoulder, and Theta (θ) in the arm of Auriga are in a line which points directly to Betelgeux in Orion, as shown in Chart XXI.

Evenings with the Stars

Objects of Interest in Auriga.—Alpha (α), or Capella, the brightest star in the constellation of Auriga, vies in brilliancy with Arcturus and Vega, the three stars being the leaders of the celestial host in the northern part of the heavens. By means of the spectroscope we have learned that Capella is similar in constitution to our Day-star, the Sun, but vastly larger and brighter, probably exceeding its lustre more than a hundredfold. Moreover, Capella is a binary star, having a small, invisible companion. The two revolve round their common centre of gravity in a period of 104 days at the rate of about 70 miles a second. The distance of Capella is such that its light requires forty years to cross the vast abyss separating it from our planet, so that we do not see it as it is *now*, but as it was *forty years* ago. For instance, if we go out and watch for Capella some fine evening in autumn when it comes peeping over the north-eastern horizon, twinkling so merrily despite the fact that it is conveying the mournful message of approaching winter, yet the Light-ray messenger actually started from Capella so long ago that on arrival its message is forty years old.

Incidentally, the transformation of the light of Capella into sound, audible in the telephone receiver, one of the latest marvellous achievements of science, may make it possible for us not only to see but to hear the message.

Auriga, the Charioteer

Capella is seen at its best early in the evenings of December and January, when it passes almost directly overhead. One cannot fail to be impressed with the beauty of its golden radiance.

Beta (β) is also known by its Arabic name *Menkalinan*, which means "the Shoulder of the Rein-holder" It is a very close binary, the two stars being only seven and a half millions of miles apart They revolve around their common centre of gravity in a period of about four days, with a relative velocity of 150 miles a second

The discovery of this double star system was made by means of the spectroscopic observations of Professor E C Pickering in 1889, who found that the lines in the spectrum of Beta doubled and undoubled every two days This indicated that the star had a companion, which cannot be seen, but whose presence is indicated by the swaying influence it exerts on the star round which it revolves When the two are nearly in the same line from the Earth the lines formed by the light blend, and seem as a single line in the spectrum, but when one star is moving from the Earth and the other moving towards it, the lines produced by the receding star are slightly shifted towards the red end of the spectrum, and those produced by the advancing star are shifted towards the blue end Thus,

Evenings with the Stars

the double lines betrayed the presence of the invisible companion, the detection of which would have been hopeless by direct telescopic research. This has been very aptly called "the astronomy of the invisible."

Gamma (γ), which from the very earliest days of descriptive astronomy has been known by the Arabic name of *Al Nath*, represents "the Heel of the Rein-holder." It is also Beta (β) of Taurus, marking the extremity of its horn, thus referred to by Aratus —

Shining in his right horn's tip
And the right foot of neighbouring Charioteer,
A single luminary links their race

Here we have another instance of one star belonging to two constellations, like that of Alpherat in Andromeda, a star which, as we have already seen, also forms part of Pegasus. Al Nath is equally the point of the horn of Taurus and the heel of Auriga. Capella (α) in Auriga, Menkalinan (β) in Auriga and Al Nath (β) in Taurus make a long triangle which covers the central part of Auriga and includes two or three misty-looking objects. When examined with a powerful field-glass, these prove to be star-clusters. In fact, the whole constellation of Auriga, situated as it is on the borders of the Galaxy, glitters with star-dust, and when setting in the west during the month of May suggested to Tennyson the simile of a "glorious

Cepheus and Cassiopeia

crown " which he refers to in the well-known lines —

It fell on a time of year
When the shining daffodil dies, and the Charioteer
And starry Gemini hang like glorious crowns
Over Orion's grave, low down in the west

On February 1st, 1892, Dr Anderson of Edinburgh discovered the addition of a guest to the stellar family of the Charioteer. The camera had also previously recorded the event on a photographic film, obtained on December 10, 1891, showing the imprint of the new star which was then of the fourth magnitude.

CEPHEUS AND CASSIOPEIA

Cepheus, King of Ethiopia, and Cassiopeia his wife, are south of *Ursa Minor*, the Lesser Bear. Cepheus is easily found by means of the three stars Alpha (α), Beta (β), and Gamma (γ), shown on Chart XX. Cassiopeia occupies a position overhead as indicated on the same chart, and is represented by a W-shaped group of stars. These are sometimes referred to as the chair on which Cassiopeia is supposed to recline, her foot resting upon the Arctic Circle. In old maps she is shown with uplifted hands, apparently still bemoaning the fate of her daughter Andromeda, despite the fact that the latter was rescued centuries ago by the gallant hero Perseus.

Objects of Interest in Cepheus.—Alpha (α), or Alderamin, according to its Arabic name, is a

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white star of the third magnitude which adorns the right shoulder of Cepheus. It comes to the highest point on the meridian on the 27th of September, but it is chiefly remarkable because it will be the Polaris or Pole-star of the year A.D. 7500. Beta (β), or Alfirk, is a double star, the components are white and blue, and it is situated about 8° north of Alpha. It is of the third magnitude. Gamma (γ), a yellow star, of the third magnitude, is about 12° from Beta. The Arabic name is Arrai, from *Al Rāi*, which means "the Shepherd."

The head of Cepheus is marked by a little triangle of fourth-magnitude stars, one of which is Delta (δ), a remarkable variable star, with a blue star as a companion. It is typical of a class of variables known as the Cepheids. The variation in their light seems to be due to a curious pulsation, as though an invisible agent were pumping gas into the star, causing it to expand during a period of $1\frac{1}{2}$ days, followed by a contraction lasting 4 days as the gas slowly evaporates. At the end of this pulsation, lasting $5\frac{1}{2}$ days in all, we can imagine the process of pumping to be repeated. Or, to use another illustration, the light curve of these stars suggests the idea of the wick of a lamp which is turned up quickly, and then slowly turned down with a scarcely perceptible halt midway.

Another variable star in Cepheus is the star

Cepheus and Cassiopeia

Mu (μ), south of Alpha (α), forming a triangle with it and Delta (δ), as shown on Chart XX. It is the so-called "Garnet Star," the name given to it by Sir William Herschel, who advises the observer to compare its colour with that of Alpha (α), a white star. It is a pretty sight viewed with an opera-glass.

The position of the neighbouring constellations with regard to Cepheus is thus described in the following doggerel lines *

Near to his wife and daughter see
Aloft where Cepheus shines,
That wife, the Little Bear, and Swan,
With Draco bound his lines,
Beneath the Pole Star twelve degrees
Two stars your eyes will greet—
Gamma, the nomad shepherd's gem,
And Kappa mark his feet

Alphirk, the Hindu's Kalpeny,
Points out the monarch's waist,
While Alderamin, beaming bright,
Is on the shoulder placed,
And where o'er regions rich and vast
The Milky Way is led,
Three stars, of magnitude the fourth,
Adorn the Æthiop's head

The star Gamma marks the radiant point of a meteor display visible annually towards the end of June, though the meteors which appear to radiate from this star are not usually very

* "The Constellations as seen in Southern India," p 128 R J ,
Pollock

Evenings with the Stars

bright or conspicuous. Observation of meteors forms a special branch of work undertaken by a section of the British Astronomical Association, and in "Telescopic Work for Starlight Evenings" (Chapter xv), by W. F. Denning of Bristol, many valuable hints are given. At the conclusion of the chapter he refers to the old idea that meteors originated gales of wind, and that, in fact, they were the heralds announcing the approach of stormy weather. This belief is expressed in Dryden's translation of Virgil.—

Oft shalt thou see, ere brooding storms arise,
Star after star glide headlong down the skies,
And, where they shot, long trails of lingering light
Sweep far behind, and gild the shades of night.

Objects of Interest in Cassiopeia.—Cassiopeia, as we have already seen, is represented on celestial maps seated on a chair in the midst of the Galaxy or Milky Way. She is surrounded by the constellations representing Cepheus, her husband, Andromeda, her daughter, and Perseus, her son-in-law.

Alpha (α), or Schedar, is a star of the second magnitude, of light red hue, and found to be variable by Birt and Sir John Herschel in 1831. It has a companion star of the ninth magnitude, a blue star discovered by Sir William Herschel in 1781, and two additional faint companions discovered by the late Professor S. W. Burnham, the noted authority on double stars.

Cepheus and Cassiopeia

Beta (β), or Caph, is a white star of the second magnitude with a small companion star almost lost in the glare of the larger. It is one of the three guides already referred to, which with Alpha in Andromeda and Gamma in Pegasus indicate the great hour circle, which cuts the equator in the Vernal and Autumnal Equinoxes (See Chart XVII, showing "The Greenwich of the Sky")

The Famous New Star in Cassiopeia.—About 5° to the north-west of Caph, a new star appeared in 1572. It was visible in full daylight, and was brighter than Venus when at its nearest to the earth. Of this new star Humboldt has preserved for us the following curious account. It was observed by Tycho Brahe, the great Danish astronomer, who described it as follows —

When I left Germany to return to the Danish shores, I stayed at the ancient and admirably situated residence of Herritzwaldt, belonging to my uncle, and I was in the habit of remaining in my chemical laboratory until night-fall. One evening, when I was contemplating as usual the celestial vault, whose aspect was so familiar to me, I saw with impressive astonishment, near the zenith in Cassiopeia, a radiant star of extraordinary magnitude. Struck with surprise, I could hardly believe my eyes. To convince myself that it was not an illusion, and to obtain the testimony of other persons, I called out the workmen employed in my laboratory and asked them, as well as all passers-by, if they could see, as I did, the star which had appeared all at once. I learned later on that, in Germany, carriers and other people had antici-

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pated the astronomers in regard to a great apparition in the sky, which gave occasion to renew the usual railleries against men of science (as with comets whose coming had not been predicted)

Its brightness exceeded that of Sirius, of Vega, and of Jupiter. It could only be compared with that of Venus when it is at its nearest possible to the earth. Persons gifted with good sight could distinguish this star in daylight, even at noonday, when the sky was clear. At night, with a cloudy sky, when other stars were veiled the new star often remained visible through tolerably thick clouds. Gradually its light began to diminish, until in March, 1574, it disappeared without a trace visible to the naked eye, having shone for seventeen months.

The star caused great excitement at the time, and by some was considered a reappearance of the Star of Bethlehem. The Chinese recorded it in their annals as Ko Sing, the Quest Star. While on view the new star changed in colour. When most brilliant it was white, then it became yellow, and afterwards red, so that for a time its hue was similar to that of Mars. Then it resumed the white tint, retaining this colour until finally it faded from view.

Objects of Interest in Perseus.—Alpha (α) or Algenib in Perseus, is a star of the second magnitude, and is of lilac hue as seen against the background of the Milky Way. It seems to be the starting-point of a curving stream of stars, like an ornamental S, drifting southward, when observed with a field-glass. Almost in a line

Perseus, the Rescuer

with Algenib in Perseus and Delta (δ) in Cassiopeia is the "Great Cluster" in Perseus, which can be seen on a clear night with the unaided eye, but it is a wonderful object when observed with a telescope. Here the stars in the clusters—for it is double—seem to be drawn together by some irresistible attraction, "in streams and rows, coronets and festoons, garlanding the black robe of night." Near it is a second cluster, the two together forming "a telescopic pageant such as, in the wildest flights of imagination, Hipparchus could little have dreamed would one day be unrolled before the eyes of men out of the cloudy spot in the sword-handle of Perseus, which he (it is said) was the first to detect."* One might almost imagine that Mrs Browning had this thought in mind when she wrote the following couplet

Perseus, even amid the stars, must take
Andromeda in chains æthereal!

The cluster presents a beautiful appearance even when seen with the limited power of an opera-glass. Seen through a telescope the glory of the sight is indescribable. In one of these clusters at least one hundred stars may be seen in an area less than a quarter of the full moon. A photograph reveals in the very heart of this wealth of stars a dark fathomless abyss, which, when magnified by means of a lantern-slide

* "The System of the Stars," p. 231 A. M. Clerke.

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projected on the screen, defies all attempts in a search for hidden stars within.

Algol, the Demon Star.—Beta (β), which is better known as Algol the “Demon Star,” or the “Blinking Demon,” from the Arabian word *Al-Ghul*, meaning the Demon or Fiend of the Woods, was said to be the evil eye of the Gorgon’s Head, used to such good effect by Perseus in turning Cetus, the Sea Monster, to stone while it was advancing with evil intent towards the helpless maiden Andromeda. The Arabians were keen observers of this star, for by the name they gave it of the “Blinking Demon” they were undoubtedly aware of its flickering light, now bright, then dim and brightening up again, like an eye opening and partly closing. This variation in light remained more or less of a mystery until the problem was solved in 1889 by means of the Sherlock Holmes of the sky, the spectroscope. On examination of its record we learned that Algol has an invisible companion which revolves around it, partly hiding the light of Algol when it comes between us and that star.

Watching Algol carefully as the Arabians did, we find that Algol is a star of the second magnitude when at its brightest, remaining so for about two days and a half. Then it begins to fade, and in the space of three and a half hours it falls to the fourth magnitude. It re-

Perseus, the Rescuer

mains faint for about twenty minutes, and then during the course of three and a half hours it is once more of the second magnitude, regaining its former brilliancy. The regularity of these changes was first discovered by John Goodricke in 1783, but another century elapsed before we learned the reason why. Now we know that Algol is really a double star, but one of the stars is dark and therefore invisible. It circles around the bright one in a path edgewise to the Earth, and when it comes between us and Algol it hides one-sixth of its light. Being smaller than Algol, which is 1,060,000 miles in diameter, the dark star, which is 840,000 miles, causes only a partial eclipse. This takes place during the three and a half hours when it is passing between us and Algol, for twenty minutes it is directly between us and that star, but by the end of another three and a half hours it has passed onward so that Algol once more regains its former brilliancy.

It is said that the famous astronomer Lalande, who died at Paris in 1807, was wont to remain whole nights in his old age upon the Pont Neuf, to show the curious onlooker the variations in the brilliancy of the star Algol. A few degrees south of Algol, and almost in a direct line with it and Alpha in Perseus, is a small third-magnitude star, Rho (ρ). This is a good star with which to compare the varying light of Algol, for when the latter is at its faintest it is not so bright

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as that star, but by the time it has regained its former brilliancy it is a whole magnitude brighter. The *Nautical Almanac* gives the time most favourable for watching these variations.

The Perseids.—During the latter part of July and the first half of the month of August the meteors known as the Perseids appear to come from a point between the stars Eta (η) and Chi (χ) which marks the great double cluster, but the radiant shifts during the period of the shower.

This stream is remarkable for its extended duration, and for the obvious displacement which occurs from night to night in the place of its radiant. It furnishes an annual display of considerable strength, and is, perhaps, the best-known system of all.*

The Perseids are known as "The Tears of Saint Lawrence," as the greatest display takes place on August 10th, his feast-day and the date of his martyrdom, which occurred in A D 258. The meteors are seen during the early part of the night at an elevation of from fifty-six to seventy miles, moving with moderate speed and leaving streaks of yellow light. They are apparently fragments of Tuttle's Comet III, which appeared in 1862, but their record can be traced back as far as A D 811. They have doubtless been wandering within the realms of the solar system for thousands of years, but

* "Telescopic Work for Starlight Evenings," p 275 By W F Denning

Perseus, the Rescuer

are now steadily decreasing in number It has been suggested that Dante had them in mind when he wrote the following stanza in the *Purgatorio* —

Vapours enkindled saw I ne'er so swiftly
At early nightfall cleave the air serene,
Nor, at the set of sun, the clouds of August

The New Star in Perseus.—A new star in Perseus was discovered early on the morning of February 22, 1901, by Dr Anderson of Edinburgh, who had already distinguished himself by detecting the presence of a new star in Auriga, in 1892 It seems that Dr. Anderson was concluding an arduous all-night watch of the heavens when, preparatory to putting in order his telescopic paraphernalia, and probably weary of his cramped position, he raised his arms upward to stretch them Happening to raise his eyes at the same time, imagine his amazement at seeing a bright star in the constellation of Perseus, which he had never seen before This group of stars was so familiar to him that an intruder in their midst must have had a startling effect. Now, one would naturally imagine that Dr. Anderson would at once have made his discovery known at the Royal Observatory at Edinburgh, but he was cautious lest someone else had preceded him However, when he called later in the morning, and no mention was made by members of the staff of any startling novelty observed

Evenings with the Stars

in stellar realms, he made known his discovery of a new star which had so impressed him during the wee sma' hours

Immediately, the news was cabled far and wide, and telescopes large and small were turned in its direction, but as it rapidly became the third brightest star in the sky, even outrivalling Capella, anyone could see the star with the unaided eye who troubled to look for it in the constellation of Perseus. After a brief reign of splendour it slowly faded away, and by the middle of April was scarcely perceptible to the unaided eye. By September, 1901, it had become invisible to the unaided eye, and by July 30, 1903, it had sunk to the twelfth magnitude and was beyond reach of any but the more powerful telescopes.

The new star, usually referred to as "Nova Persei," seems to have blazed out with extraordinary rapidity, for according to a photographic record obtained on February 19, 1901, or three days before the discovery made by Dr. Anderson, it was shown to be as faint as the eleventh magnitude. Therefore, by the morning of February 22 it had risen from that magnitude to the first, within three days. This difference corresponds to an increase of the light ten-thousandfold. Imagine what would happen to our planet should such an outburst, accompanied by a corresponding increase in heat, occur on our Day-star, the Sun!

Cetus, the Whale

By means of photography we were enabled to follow further developments in the history of the new star, which during the process of fading became enwrapped in nebulous folds. These spread outward in spirals until a small star, which in the earlier photo appeared far out in a clear sky, is shown in later photos almost hidden in these voluminous folds. Some say that the sudden blaze of the star caused a progressive illumination of the surrounding nebula, while others are of the opinion that its appearance was due to effects produced by the subtle agency of light-pressure *

CETUS, THE WHALE

This constellation, which is the largest in the heavens, occupying a space of 50° in length, and six weeks in passing the meridian, is of very early antiquity. By the Greeks it was connected with the story of the Nereids, who, indignant at Cassiopeia's vain boast of her daughter's superior beauty, appealed to Neptune to avenge the slight with regard to their own claims in that direction. As we have already seen, Cetus was the monster sent to devour Andromeda, who was chained to a rock by the order of Neptune,

* "The weight of opinion ultimately favoured Professor Very's hypothesis that the nebulous structure connected with Nova Persei resulted from its actual emission of minute particles under the stress of electrical repulsion, or the subtle agency of light-pressure" — "System of the Stars," p 95 A M Clerke

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but was turned to stone on the opportune arrival of Perseus

Alpha (α), or Menkar, a star of $2\frac{1}{2}$ magnitude, and of a bright orange colour, marks the monster's open jaws. Gamma (γ) is a very pretty double star, but rather close for a small telescope, the components being only 2.5" apart. Their colours are yellow and blue.

Beta (β), or Deneb, is a yellow star of 2.4 magnitude, and brighter than Alpha, so that it must have increased in splendour since the stars were registered by Ptolemy, who placed Alpha first on the list. Miss A. M. Clerke asserts that this increase in brilliancy took place in the eighteenth century.

Mira, the Wonderful Star.—Omicron (\omicron), or Mira, the "Wonderful Star," is the leading attraction in the constellation of Cetus. On old maps it is shown adorning the neck of the Whale. Cetus, by the way, is a ferocious-looking monster with forked tongue protruding from between its enormous jaws, gigantic claws, and a most serpentine, dangerous-looking tail.

Mira is a long-period variable star, changing from maximum to minimum, and reaching maximum again within a period of about eleven months. For about five months it is invisible to the unaided eye, then it makes its appearance, gradually increasing in brightness during a period of three months, and finally blazing forth as a

Cetus, the Whale

star of the second magnitude, thus increasing a thousandfold in brightness. This lasts for a week or ten days, when during another period of three months it gradually returns to its former obscurity. Woe betide the amateur who mistakes it for a new star, as sometimes happens, since its sudden apparition in a space hitherto vacant is very apt to be misleading. Therefore the star Mira needs very careful watching, and the famous variable is well worthy of special attention.

During the course of the year Cetus is visible from October until the end of March, but during most of that period Mira may be at its minimum. However, a careful scrutiny of the space between Gamma (γ) and Zeta (ζ) may be rewarded some evening by a glimpse of a faint object which gradually brightens until it has reached its maximum splendour. For instance, in 1779 Mira was almost equal in brightness to a first-magnitude star, but frequently it does not exceed that of a second-magnitude.

This variation in the brightness of Mira was first observed by Fabricius fully three centuries ago, for he noted that while it was of the third magnitude in August, 1596, it had become invisible in the following autumn. The star has a period of about 331.3 days, but its variations are somewhat erratic.

TWELFTH EVENING

*ORION, LEPUS, ERIDANUS, TAURUS, THE HYADES AND
THE PLEIADES, CANIS MAJOR, CANIS MINOR, AND GEMINI*

When chilling winter spreads his azure skies,
Behold Orion's giant form arise

(ARATUS)

FROM time immemorial the constellation of Orion has attracted attention. On old maps he is represented as a mighty giant warding off the attack of Taurus. In his left hand he holds the skin of a lion as a shield, in his right he wields a huge club, and a massive sword hangs from his belt According to Manilius —

His arms extended stretch o'er half the skies,
His stride as large, and with a steady pace
He marches on, and measures a vast space ,
On each broad shoulder a bright star display'd,
And three obliquely grace his hanging blade
In his vast head, immersed in boundless spheres,
Three stars, less bright, but yet as great, he bears,
But farther off removed, their splendours lost ,
Thus grac'd and arm'd, he leads the starry host

The Belt of Orion is sometimes called "the Ell and Yard," because the central star divides it into two unequal parts The Belt is three degrees in length, and serves as an excellent pointer, indicating the star Aldebaran in the constellation of Taurus, to the right, and the star Sirius, in

Orion, the Giant

Canis Major, the Great Dog, to the left The three stars are sometimes called "the Three Kings," and they are also the Bands of Orion, mentioned in Holy Writ, in the Book of Job — "Canst thou bind the sweet influence of the Pleiads, or loose the bands of Orion?"

As we have already seen, Orion is vividly described by the Latin poet Manilius, Homer pictured him on the shield of Achilles, and Virgil mentions him in the third book of his *Æneid* as "Bright Orion, arm'd with burnished gold" Among the Chaldeans, Persians, Hindus, Arabians, and Egyptians this constellation was well known under various names It has also given rise to many legends, and an account of one of the strange adventures of Orion forms a picturesque setting for Longfellow's poem entitled *The Occultation of Orion*

Thus, during winter evenings we can see outlined among the stars these fanciful myths of olden times During endless centuries the mighty giant has been seen, striding with martial step from the east to the western horizon, closely followed by his favourite dogs, Sirius and Procyon He seems oblivious of the timid hare crouching at his feet, which is perilously entrapped between the River Eridanus on the one side, and Sirius on the other

Behind him Sirius ever speeds as in pursuit, and rises after,
And eyes him as he sets

Evenings with the Stars

Orion was known of old as the "Lord of the River Bank," associated with the fact that great rains and storms so dreaded by mariners in the early days of navigation were prevalent at its rising. Thus Hesiod wrote :—

Then the winds war loud,
And veil the ocean with a sable cloud

And Milton refers to the dangers of navigation at such times .—

When with fierce winds Orion arrived
Hath vexed the Red Sea coast

Although the quaint legends regarding such personalities as Orion and others among the stars may seem childish, yet they serve the useful purpose of helping an amateur to locate the position of the different groups of stars with regard to each other. As Aratus tells us, "Some mortal noting in ages long ago" a likeness to the outline of beings and animals among the stars —

Assigned judiciously a common name
To aggregated multitudes, it had passed his skill
Nor aided recognition to have given particular
Names to every luminary,
Thronged as they are, and each to other like
In size and hue and in their circling orbs
So he devised to group them in such wise
That standing in succession side by side
They simulated living forms. Easily thus he named
Heaven's host and now no star rises unrecognized
Of those that are arranged in definite forms
Conspicuous. Those beneath the hunted Hare
Wander unformed and nameless in the gloom

Orion, the Giant

However, since the days of Aratus the stars in southern skies "beneath the hunted Hare" have been grouped and named, at first as in the case of Argo the Ship and the Southern Cross with artistic skill, but otherwise the choice of names shows lack of originality. There is an odd mixture of a Triangle, a Fly, a Telescope, a Bee, a Peacock standing proudly on its head, a Compass, a Bird of Paradise, a Clock, a Net, a Sextant, a Fox and many others oddly intermingled.

Objects of Interest in Orion.—Orion is one of the finest constellations in the heavens, and is so placed that it can be seen from every part of the globe. It is true it appears inverted in southern skies, but that does not detract from its splendour. Nevertheless, one misses the fine effect produced in northern skies as the Giant slowly arises early in the evenings of October and November from a recumbent position on the eastern horizon, standing erect while advancing southward, then sloping as he sets over his grave "low down in the west" during the early evenings of March and April. Somehow his departure seems more impressive than his arrival, possibly because such brilliants as Aldebaran, which precedes him, Sirius and Procyon, the Twins Castor and Pollux, which follow, Capella, Regulus, Spica, Arcturus, and Vega, are all visible in the heavens at the same time.

Evenings with the Stars

Alpha (α), or Betelgeux, its Arabic name, adorns the right shoulder of Orion ; and Gamma (γ), or Bellatrix, the Amazon Star, is on the left. Betelgeux is of the first magnitude, and is one of the giant stars, for, according to the measurements recently made with an interferometer attachment to the 100-inch reflector at Mount Wilson, its diameter is found to be two hundred and fifteen million miles. Were it placed centrally on the Sun, its rim would extend outward nearly as far as the planet Mars. It was described by Lassell "as a rich and brilliant gem, a rich topaz in hue and brilliancy, differing from any I have seen." It is not only remarkable on account of its colour and brilliancy, but also as being one of the most famous variable stars in the heavens. It was first observed to be variable by Sir John Herschel in 1836, who described its variations at this period as most marked and striking.

Beta (β), or Rigel, marking the left foot of the Giant, is the brightest star beneath the three in his belt. It is of the first magnitude, and its colour is bluish white. Turn an opera-glass in its direction, and compare its colour with that of Betelgeux, the contrast is startling, showing, indeed, how "one star differeth from another in glory." Although lettered below Betelgeux, it is usually superior to it in brightness, rivalling Arcturus, Capella, and Vega. A



"HORSE S HEAD NEBULA IN ORION

Photographed at Mount Wilson Observatory by Duncan with the Hooker Telescope, or 100-inch reflector, showing a dark, cosmic mass south of *Zeta Orionis*

Orion, the Giant

three-inch telescope reveals the presence of a blue companion star, of the seventh magnitude.

Gamma (γ), or Bellatrix, is pale yellow in colour and of the second magnitude. According to a myth told by the natives of the Amazon River, Bellatrix figures as a young boy in a canoe with an old man, represented by the star Betelgeux. They are said to be chasing the Peixie Boy, a dark spot in the sky near Orion, and one immediately connects it with the remarkable dark spot beneath the third and lowest star in the Belt, familiarly termed "the Horse's Head," as suggested by its outline. However, the keen eyes of the natives would be unable to detect an object which is invisible even with the most powerful telescopes, and remained so until its presence was revealed by means of photography. It is not one of the vacant regions of the sky, such as Herschel termed "Windows in Heaven," but is an opaque mass, either a dark nebula composed of the debris of stellar space, or material from which in the course of time bright nebulae and stellar systems may be evolved.

An opera-glass turned in the direction of —

those three stars of the airy Giant's zone

That glitter burnished by the frosty dark,

as Tennyson describes them in *The Princess*, will show a myriad twinkling lights, recalling the Arabic name of the middle star Epsilon (ϵ), known also as *Al Nathn*, which means "the

Evenings with the Stars

String of Pearls," set in the centre of Orion's Belt

Delta (δ), the uppermost of the three stars, has the Arabic name *Mintaka*, which means "the Giant's Belt." It is a wide double, the larger star being of the second magnitude, the smaller of the seventh, and their colours are both white. Professor Burnham discovered another companion star, which has been described as the faintest ever seen near a bright star.

Epsilon (ϵ), the second and middle star in the belt, has a distant blue companion, but it is too faint to be seen without the assistance of a telescope. Zeta (ζ), the lowest star in the belt, has the Arabic name *Al Nitah*, which means "the Girdle." It is a triple star of the second, sixth, and ninth magnitudes, and the colours are respectively yellow, purple, and grey.

Beneath the belt are the stars of the sword, the lowest being Iota (ι), or *Nāir al Saif*, according to its Arabic name, meaning very appropriately "the Bright One in the Sword." It is a triple star, white, blue, and red, the tricolour apparently of Orion, and it is nebulous as well. Thus adorned is

Orion with his glittering belt and sword

Gilded since time has been, while time shall be

Clinging around Theta (θ), the middle star in the sword of Orion, is a hazy-looking mist.

That marvellous round of milky light
Below Orion.

Orion, the Giant

When seen with an opera-glass it is a little more clearly defined, but with a telescope of three inches aperture Theta is separated into four stars which form the so-called "Fish's Mouth" or Trapezium. This is an irregular square with a star at each corner, and is situated in the midst of a dark gap in the nebula, within which the four stars gleam brightly. The radiant mist surrounding them has a greenish tinge, revealing the vast stellar cloud known as "the Nebula in Orion" with its—

Isles of light and silvery streams
And gloomy gulfs of mystic shade

Professor Barnard described it as resembling a ghostly bat flitting through the shades of night, but words fail to describe the wonders revealed by the photographic plate on which have been imprinted vague outlines of this marvellous object. One of the first—if not the first—of the photographic records of this wonderful nebula in Orion was obtained in 1881 by Dr. Draper of New York, and is thus described by my father in his book entitled "The Universe of Suns," (page 136) —

For nearly an hour, in Dr Draper's study, I had that negative before me, and I could have passed many hours, absorbing, so to speak, the evidence it gives respecting the Orion nebula. The longer it was studied the more detail could be seen in it—no picture of the nebula which I have ever seen—though the finest views by Rosse, Lassell, Secchi, John Herschel, and others,

Evenings with the Stars

have come under my scrutiny—no view of the nebula I have ever had, even with the most powerful telescope, was to me half as instructive or as impressive as this little picture. More detail was here, though only the study of a microscopic eye could recognize it. But that was not all, the thought that seemed so impressive, so thrilling, as to surpass even the feeling of awe with which in the solemn darkness of night we see some mighty group of suns sweep into the field of view of the telescope—was this, that here on this tiny square inch of shoreline, with its thin film of chemical sands, had been received the impress of waves which for years had been traversing the solemn depths of space.

Over those millions of millions of miles had they swept in their swift rush, at a rate which would circle seven times the entire circumference of the earth in a single beat of a second's pendulum, and here on this square inch of glass had they left their message, picturing here for us a nebulous mass, occupying billions of billions of cubic miles of space, but so remote that to the unaided eye the entire nebula appears but as a faint speck of misty light clinging around one of the fainter stars in the sword of the Giant Orion. Here we have mirrored by Nature herself 'that marvellous round of milky light below Orion.' I know no greater achievement of physical science.

This was written in 1882, but since then the advance not only in celestial photography, but the increase in the light-grasping power of telescopes, has been so great that more and more detail has been revealed within those "gloomy gulfs of mystic shade." I have before me one of the most recent photographs taken of the Nebula in Orion. It was obtained on November



THE GREAT NEBULA IN ORION

Photographed at Mount Wilson Observatory with the Hooker Telescope, or 100-inch reflector

Lepus, the Hare

19, 1920, exposure 3 hours, with the great 100-inch reflector at the Mount Wilson Observatory, and it shows more detail than words can adequately express. Here we see, as Tennyson described it in *The Palace of Art* (first edition only)—

Regions of lucid matter taking form,
Brushes of fire, hazy gleams, clusters and
 beds of worlds,
And bee-like swarms of starry streams.

LEPUS, THE HARE

Below Orion is Lepus, the Hare, of which constellation Aratus wrote

And ceaselessly beneath Orion's feet
The Hare is ever chased

The four principal stars of this constellation were called by the Arabs "the Throne of the Giant," although it would have been more appropriate to describe them as his footstool, to judge from the size of the constellation as compared with Orion, the Giant referred to in these lines.

In early Egyptian astronomy it was the Boat of Osiris, the great god of that country, identified with Orion. Wonder has often been expressed regarding the position of the timid hare in connexion with a mighty giant, but the problem is solved when it is recalled that originally Orion was a type representing the Sun, and that the hare was almost universally typical of the

Evenings with the Stars

Moon. There is, in fact, a singular connexion between the hare and the Moon, as shown in Euphratean cylinders, Syrian agate seals, Chinese coins, the moon-cakes of Central Asia, and in the legends of widely separated nations and savage



THE HARE, A CHINESE SYMBOL OF THE MOON
(Represents also their zodiacal sign of the Scorpion)
From "L'Astronomie Chinoise" (Saussure)

tribes Among Chinese celestial emblems, the Hare is a zodiacal constellation, and as a symbol of the Moon it is represented as a hare diligently pounding drugs in a mortar. The design (*see* accompanying diagram) was reproduced from a Chinese work of art, A D 1730, but in this case it does not tally with our constellation *Lepus*, but with the zodiacal sign we call the Scorpion, so the connexion seems rather far-fetched.

Hind's Crimson Star.—*Lepus* is mainly of interest on account of its variable star *R*, dis-

The River Eridanus

covered by Mr J. R Hind in 1845, and known as "Hind's Crimson Star" It lies in front of the Hare's head, and at first its discoverer announced it as belonging to Orion Its light varies in a very irregular period of about four hundred and thirty-eight days, and this variation was first recorded by Schmidt in 1855. It was described by Hind as of the most intense crimson, resembling a drop of blood on the background of the sky As regards depth of colour, no other star visible in these latitudes, we are told, could be compared with it in the sky. *Lepus* appears so near the horizon that it can only be well seen on the meridian, but no opportunity for observing it should be neglected.

THE RIVER *ERIDANUS*

The constellation of Eridanus covers a large and irregular space in the heavens, terminating in the bright first-magnitude star Alpha (α) or Achernar, too far south to be seen in these latitudes. For convenience of reference, this straggling group of stars is divided into two streams, known as the Northern and the Southern. The Northern stream is between Orion and Cetus the Whale, and begins near Rigel in the foot of Orion, flowing out westerly in a serpentine course as far as the star Eta (η). Here it makes a complete circuit, returning in nearly the same

Evenings with the Stars

distance towards its source, when it again bends curving to the south-west and finally disappears below the southern horizon

Eridanus is the name of a celebrated river in Cisalpine Gaul Virgil calls it "the king of rivers," and according to Greek mythology it was the river into which Phaeton fell when he made an attempt—

To guide the sun's bright chariot for a day

According to the legend his sisters mourned his unhappy end, and were changed by Jupiter into poplars.—

All the long night their mournful watch they keep,
And all the day stand round the tomb and weep
(OVID)

TAURUS, THE BULL

To the right of Orion is the constellation of Taurus, which is now the second *sign* and third *constellation* of the Zodiac, but more than 4,000 years ago the Bull was leader of the Celestial Host The Ram followed, and now, as we have already seen, the Fishes lead the year A glance at Chart XXI will show that Taurus is situated between Perseus and Auriga on the north, Gemini on the east, Orion and Eridanus on the south, and Aries (see Chart XX) on the west. According to the mythology of the Greeks, this is the animal which bore Europa over the seas to that country which derived from her its name. She

Taurus, the Bull

was the daughter of Agenor, and Princess of Phœnicia, and of such beauty that Jupiter, seeing her, assumed the shape of a snow-white bull so that he might mingle with the herds of Agenor and come near her while she was gathering flowers in the meadow with her companions.

Europa caressed the animal, placing a garland of flowers around its neck, and finally ventured to climb upon its back. No sooner was she seated than Jupiter took advantage of the situation and, plunging into the sea, crossed with his fair burden in safety to the island of Crete. In his *Palace of Art*, Tennyson alludes to this capture of Europa, in the lines—

Sweet Europa's mantle blew unclasp'd,
From off her shoulder backward borne,
From one hand droop'd a crocus, one hand grasp'd
The mild Bull's golden horn

Jupiter's exploit, it seems, was made memorable by the naming of the continent Europe on earth, and by the constellation of Taurus in the sky. But Taurus, like most of the zodiacal constellations, is really far older than Greek mythology. In the ancient zodiacs of Egypt it was probably connected with the worship of Apis, the bull, and is also to be found in the ancient astronomical records of Chaldea and India. Virgil thus refers to the time when the year began in March

The White Bull opens with his golden horns the year.

Evenings with the Stars

The Bull was an important object of worship with the Druids, and in the festival of May Day is to be found a survival of the great Tauric festival held when the Sun entered that constellation. According to a Scottish myth, the Candlemas Bull is seen rising in the twilight on New Year's Eve.

Objects of Interest in Taurus.—The constellation of Taurus is chiefly remarkable for the bright star Alpha (α), better known by its Arabic title Aldebaran, which means "the Follower" Glowing with the ruddy hue of a ruby, low down a little north of the eastern horizon it may be seen rising at eight o'clock in October. It follows closely after the Pleiades, which make their appearance an hour earlier, adorning the sky with their quivering misty light—hence the Arabic name signifying "the Follower." From the time it is first seen until late in December, Aldebaran occupies a conspicuous position in the eastern heavens early in the evening. During the autumn it vies in splendour with Capella in the north, and gleaming Fomalhaut in the southern sky, sharing with the latter the honour of being one of the four "royal" stars or "Guardians of the Sky" of Persia 5,000 years ago, when it marked the Vernal Equinox. (The remaining three, as already noted, are Antares in the Scorpion, Regulus in the Lion, and Fomalhaut in the Southern Fish.)

Taurus, the Bull

Aldebaran is a ruddy star of the first magnitude, and the fourteenth on the list of the brightest in the heavens. Compare its colour with the blue-white radiance of Rigel, the pearly lustre of Capella, the orange hue of Betelgeux, and the diamond blaze of Sirius. Aldebaran is accompanied by a minute companion, too faint, however, to be seen without the aid of a good telescope. Occultations of the star by the Moon are not infrequent, and a brief announcement of these interesting celestial events is usually given in the daily papers, or can be found in almanacs. An occultation may be observed with the unaided eye, and it is a pretty sight to witness the star drawing nearer and nearer to the Moon—as it were—and then suddenly vanishing as though by the agency of an extinguisher. No skill or optical assistance is needed to watch the display, which can be seen and enjoyed by anyone who takes the trouble to watch at the appointed time. When Aldebaran was thus suddenly extinguished on May 5, 1924, the atmospheric conditions being perfect, the abrupt disappearance of the star gave the writer a shock, as though Aldebaran had actually vanished from out of the sky. But later on it returned to cheer us with its ruddy light—its reappearance being just as sudden presumably as its exit, though it must be confessed the night was too chilly to wait and see.

Evenings with the Stars

Beta (β), a star of the second magnitude, shares, as we have already seen, the honour of belonging to the two constellations Taurus and Auriga. Thus, as Aratus describes it, Beta or *Al Nath*, according to its Arabic title, adorns

The tip of the left horn, and the right foot
Of the near Charioteer

It will be remembered that between this star and Psi (ψ) in Auriga a new star—the famous “Nova Aurigæ”—suddenly blazed out in 1892, and was discovered by Dr. Anderson of Edinburgh

Zeta (ζ), a star of the third magnitude, marks the tip of the southern horn of the Bull. A little to the north-west is to be found the Crab Nebula, so named on account of its crab-like appearance. It can be seen with an opera-glass, but a telescope is required to show the sprays of nebulous matter which first suggested its name. In 1835, when astronomers were on the watch for the return of Halley's comet, the Crab Nebula was mistaken on several occasions for the expected visitor.

THE HYADES AND THE PLEIADES

When the horns of Taurus are observed with an opera-glass, a small stream of stars seem to be suspended therefrom, “sprinkling his forehead o'er” as Aratus describes them. Thus :

. . . with his golden horns in full career
The Bull beats down the barriers of the year.

The Hyades and the Pleiades

The Hyades may readily be distinguished by the V-shaped group of stars, tipped on the left with the bright star Aldebaran. The Hyades, according to Greek mythology, were said to be the daughters of Atlas, and half-sisters of the Pleiades. It is said they were changed into stars on account of their grief at the death of their brother Hyas.

The poets called them the "watery Hyades," and Pliny described them collectively as "a violent and troublesome star, causing storms and tempests raging both on land and sea." Tennyson, in his *Ulysses*, referred to them as follows —

Thro' scudding drifts the rainy Hyades vext the dim
sea

Virgil described Palinurus, the renowned pilot of the Trojan fleet, as watching the face of the nocturnal heavens and noting their sliding course

The Pleiads, Hyads, and their wat'ry force

Indeed, this pilot was so intent on watching the stars on one memorable occasion that it is said he fell overboard,

and struggling in the main

Cried out for helping hands, but cried in vain

According to fable the Pleiades were the seven daughters of Atlas and Pleione. Their beauty attracted the attention of the mighty

Evenings with the Stars

hunter Orion, who pursued them across wood and dale. Hearing their cries for help, so the story goes, Jupiter changed them into doves, and afterwards placed them among the stars. Their names have been thus recorded by Aratus.—

These the seven names they bear
Alcyone and Merope, Celæno,
Taygeta, and Sterope, Electra,
And queenly Maia, small alike and faint,
But by the will of Jove illustrious all
At morn and evening, since he makes them mark
Summer and winter, harvesting and seed time

Hesiod, who wrote about 200 B.C., shows how they were observed in his time as signs for the seasons —

When, Atlas-born, the Pleiad stars arise
Before the sun above the dawning skies,
'Tis time to reap, and when they sink below
The morn-illumined west, 'tis time to sow.

The Pleiades are also called the “Virgins of Spring,” because the sun enters this cluster in the “season of blossoms” about May 18. In South Africa they are known as the “hoeing stars,” and their last visible rising after sunset has been celebrated with rejoicing all over the southern hemisphere as a sign of coming activity in agricultural pursuits.

Alcyone, the brightest star in the group, was at one time thought to be the central star of the Universe, around which all the other stars in the

The Hyades and the Pleiades

heavens revolved. However, this fascinating theory advanced by Dr. Madler is no longer accepted, our conception of the Universe, founded on the wonders revealed by means of photography, being on a vastly grander scale.

Then there is the well-known legend of the Lost Pleiad, according to which one of the seven sisters does not shine so brightly as the others. Greek myth accounts for this by saying that the faint star is Electra, who hid her face at the burning of Troy, but apparently she has recovered from her fright, as she now shines as brightly as her sisters. Others say that the Lost Pleiad is Merope, who married a mortal while her sisters married gods, and for this reason she is eclipsed by them in splendour. However, science has come to our aid in solving the mystery, for when the Pleiades were photographed in 1888 by Paul and Prosper Henry, it was found that the seven stars were veiled in nebulous folds clinging around the stars and filling the spaces between with filmy star mist and wreaths as of stellar gauze. Thus was Tennyson's picturesque description verified in the well-known lines—

Many a night I saw the Pleiads rising through the
mellow shade,
Glitter like a swarm of fireflies tangled in a silver
braid

The Pleiades are literally a swarm of suns

Evenings with the Stars

drifting together in one direction: six stars—according to the German astronomer Bessel—are lagging behind, as though exhausted by this stupendous journey across the depths of space and two are in advance like heralds announcing the approach of this mighty army. No longer is it merely composed of the seven sisters, escorted by their father Atlas and Pleione their mother, for photography has not only revealed the filmy star mist veiling the seven bright stars, but in their neighbourhood an innumerable host of stellar orbs, which Miss A. M. Clerke compared to “battalions of stars, marching in widely extended ranks, by a concerted plan, along a prescribed track, under orders sealed perhaps for ever to human intelligence.”

However, a great advance has been made in our knowledge of stellar movements through the recent researches of Professor Eddington and others, and it would seem as though the “sealed orders” have been partly deciphered. Apparently the Pleiades and their stellar adherents form part of one of the great star-streams which are passing athwart each other, while a third stream, seemingly stationary, is the one to which our own stellar system belongs, and from which we are watching the passing throng.

After attending a meeting of scientists where such weighty matters as stellar movements are discussed, one recalls the stanza by Walt Whit-

Canis Major, the Great Dog

man, in which he expresses the feeling of awe which oppressed him

Rising and gliding out I wandered off by myself
In the mystical moist night air, and from time to time
Looked up in perfect silence at the stars

CANIS MAJOR, THE GREAT DOG

The constellation of *Canis Major* is chiefly remarkable on account of its leading brilliant Alpha (α) or *Sirius*, to which Aratus thus refers

In his fell jaw
Flames a star above all others with searing beams
Fiercely burning, called by mortals *Sirius*

On star maps the Dog is represented standing on his hind paws, watching his master Orion, but with an eye on the crouching Hare at his feet. In the remote ages the rising and setting of this group of stars was watched with the keenest interest. The ancient Thebans, who first cultivated astronomy in Egypt, determined the length of the year by the number of its risings, as heralding the rising of the Nile, which they called *Siris*. Thus it warned them of its overflow, enabling them to escape from the inundation which followed

At that period the dog-days commenced on August 4, and lasted forty days or until September 14, during which time, as Virgil states—

Parched was the grass, and blighted was the corn
Nor 'scape the beasts for *Sirius* from on high
With pestilential heat infects the sky

Evenings with the Stars

The dog-days of modern times have no reference whatever to the rising of Sirius, because the *time* of its rising is perpetually hastened by the precession of the Equinoxes. Thus, the dog-days at present begin on July 3 and continue until August 11, one day less than reckoned by the ancients. Why Sirius, which is seldom seen until mid-winter, should be associated with the heat of summer is explained by the fact that this star in summer is overhead in the day-time, but is invisible owing to the glare of sunlight.

Sirius is easily found in the night sky during the winter months, not only on account of its intense brilliancy, since it is the brightest star in the heavens, but by means of the three stars in the Belt of Orion, which point downward in its direction. Its colour is a dazzling white, but when seen near the horizon it flashes with all the colours of the rainbow. As Tennyson describes it—

The fiery Sirius alters hue
And bickers into red and emerald

Sir William Herschel says that when he turned his large, four-foot mirror on this star the light was like that of the rising Sun, and it was impossible to look at the star without pain to the eye. Even when seen with an opera-glass the eyes are dazzled by its splendour. In "Half-Hours with the Telescope" (page 38),

Canis Major, the Great Dog

my father describes his experience as follows, and it seems of special interest, as, when a child, the writer has memories of seeing Sirius many times through the telescope to which I have referred.

On looking through a telescope towards Sirius, a glare of light will be seen within the tube. Now, if the tube is slightly moved about, the light will be seen to wax and wane, according as the tube is more or less accurately directed. Following these indications, it will be found easy to direct the tube so that the object-glass shall appear *full of light*. When this is done, insert the eyepiece, and the star will be seen in the field. Now focus the telescope by turning the small focusing screw. Observe the charming chromatic changes—green and red and blue light, purer than the hues of the rainbow, scintillating and coruscating with wonderful brilliancy. As we get the focus, the excursions of these light flashes diminish until, if the weather is favourable, the star is seen, still scintillating, and much brighter than to the unaided eye, but reduced to a small disc of light, surrounded (in the case of so bright a star as Sirius) with a slight glare. If after obtaining the focus the focusing rack-work be still turned, we see a coruscating image as before. In the case of a very brilliant star these coruscations are so charming that we may be excused for calling the observer's attention to them. The subject is not without interest and difficulty as an optical one. But the astronomer's object is to get rid of all these flames and sprays of coloured light, so that he has very little sympathy with the admiration which Wordsworth is said to have expressed for out-of-focus views of the stars.

Sirius has been termed the "King of Suns," as compared with our Day-Star, since its light,

Evenings with the Stars

according to Sir David Gill, exceeds that of our Sun more than forty times, but owing to its greater distance "it seems to cast a dim and weaker ray." Nevertheless, its mass is only twice as great as that of the Sun, so that its diameter is probably not very much in excess of that of the Sun¹ (Recently, it has been found that with Alphecca in the Northern Crown, Beta in Auriga, Delta in the Lion, and some fainter stars, Sirius shares, with the seven stars of the Plough, the star-drift detected by my father in 1868)

Nestling in the dazzling glare of Sirius is a little companion star of the ninth magnitude, which was discovered in January, 1862, by Mr. Alvan Clark while testing a fine new telescope on Sirius. Suddenly, while looking at the star, he exclaimed :

"Why, Father, the star has a companion!" The startling statement was instantly verified, for there indeed was a small star due east from Sirius, and distant about ten seconds. Its motion has been found to account for a hitherto unexplained vibratory motion of Sirius, around which it is now known to revolve during a period of $49\frac{1}{4}$ years, in an orbit twenty times greater than that of the Earth around the Sun.

It is a very faint star of a yellowish hue, and when it is stated that Sirius exceeds it in lustre

* "The Star World," p. 197 Dr. A. C. Crommelin

Canis Minor, the Little Dog

four thousand times, one can understand why it was not readily captured, although suspected and sought for as far back as 1844. Sirius and its companion star are comparatively near, as the light from Sirius requires but eight and a half years to reach us. Therefore, when we take the first opportunity to look at this star, we shall see it not as it is *now*, but as it *was* more than eight years ago, when its light message started in the direction of our planet.

In the story of "Micromégas," Voltaire describes the inhabitants of an imaginary planet circling round Sirius. That world was said to be twenty-one million times larger in circumference than the Earth, and the inhabitants were twenty miles in height. When Micromégas, who was of average height, visited our planet, he was able to step over mountains and wade across oceans with the utmost ease. Scooping up a handful of tiny atoms he found moving about, he examined them critically through a powerful microscope, and discovered that they were beings endowed with speech. By an ingenious contrivance, he succeeded in conversing with them, and was amazed at the overwhelming conceit of these infinitely minute creatures!

CANIS MINOR, THE LITTLE DOG

It is probable that the Egyptians were the inventors of this constellation, as its leading star

Evenings with the Stars

Procyon rises half an hour before the Great Dog, Sirius, thus warning the dwellers on the banks of the Nile of its approach at a time of year when the appearance of that star was most dreaded. Procyon is a word derived from two Greek words meaning "before the Dog" Thus :

illustrious through the skies
Beams Procyon, justly by Greece so-called,
The bright forerunner of the greater Dog

Arabian astronomers called it "*Al-kelb-al-mutekadden*," a very long name for such a very wee dog, but meaning practically the same thing as Procyon. Like Sirius, it was a star of ill-omen in connexion with the weather. "What meteoroscooper," wrote Leonard Digges, the astrologer, "yea, who that is learned in matters astronomical, noteth not the great effects at the rising of the star called the *Litel Dogge*?"

Interesting Facts about Procyon.—Procyon is one of the ten brightest stars north of the Equator, being sixth in order of magnitude (as determined photometrically at Harvard). Although inferior to Sirius (which ranks first in splendour), it is a fine object when seen with a telescope.

On referring to "Half-Hours with a Telescope" (page 44), containing a record of my father's personal observations of the stars, I see that he describes the leading brilliant of *Cant's Minor* as follows "Procyon, the first-magni-

Canis Minor, the Little Dog

tude star between Præsepe and Sirius, is finely coloured yellow, with a distant orange companion which appears to be variable" This undoubtedly is one of the "several distant attendants" referred to by Mr T W Webb in "Celestial Objects for Common Telescopes" (Vol II, page 69, sixth edition), as the companion star of Procyon was not discovered until thirty years after this book was written The discovery was made on November 16, 1896, by Professor Schaeberle of the Lick Observatory.

Almost half a century before Procyon was shown to be a double star, the famous German astronomer Bessel announced that he had come to the conclusion that both Sirius and Procyon were binary systems, each consisting of a visible and an invisible star So faint is the companion of Procyon that it would take twenty thousand such stars at the same distance as the Sun to give us the same amount of light as we receive from the Sun. This small star moves round Procyon once in forty years

Canis Minor contains a star of the third magnitude, which has the Arabic name *Gomelza*. In old star maps it is shown as an ornament on the Dog's collar This star is Beta (β), and it is so placed with regard to Alpha (α) or Procyon that the two are sometimes mistaken by the beginner for Gemini, the Twins, but the following hint will show how easily that

Evenings with the Stars

mistake can be avoided. An imaginary line drawn from Rigel through Betelgeux in Orion points directly to Pollux. Once he is located it is an easy matter to find his brother Castor, for the two are as inseparable in the sky as their namesakes were on earth.

GEMINI, THE TWINS

Gemini, the Twins, have been regarded as such from time immemorial. According to the mythology of the Greeks, Castor was killed during a battle, and Pollux, unwilling to survive his brother, implored Jupiter either to restore Castor to life or to deprive Pollux himself of immortality. Jupiter granted his appeal by permitting Castor to share the immortality of his brother, placing both among the stars. Consequently, they lived and died alternately every day. According to Homer :

By turns they visit this ethereal sky,
And live alternate and alternate die.

In the Argonautic expedition, during a violent storm, it is said two flames of fire, "St Elmo," or "Ledeian lights" (so-called as Castor and Pollux were the sons of Leda), were seen to hover around the heads of the Twins, whereupon the storm ceased and the sea became calm. As Horace wrote in the *Odes* :

So Leda's twins, bright shining, at their beck
Oft have delivered stricken barks from wreck.

Gemini, the Twins

Thus the stars Castor and Pollux were regarded as the sailor's stars and as protectors of navigation. According to Greek myth, Neptune gave the brothers power over wind and wave, to which Macaulay refers in his *Lays of Ancient Rome*.

Safe comes the ship to haven
Through billows and through gales,
If once the great Twin Biethien
Set shining on the sails

Homer in his hymn to Castor and Pollux, as translated by Shelley, thus alludes to their supposed influence over the sea.

These are the powers who earth-born mortals
save,

And ships, whose flight is swift along the wave
When wintry tempests o'er the savage sea
Are raging, and the sailors tremblingly
Call on the Twins of Jove with prayer and vow,
Gathered in fear upon the lofty prow.

. . . they suddenly appear,
On yellow wings rushing athwart the sky,
And lull the blasts in mute tranquillity,
And strew the waves on the white ocean's bed,
Fair omen of the voyage, from toil and dread
The sailors rest, rejoicing in the sight,
And plough the quiet sea in safe delight

Thus, escorted by the Twins, we have reached the end of our ramble in Starland, during which we have visited each constellation in turn. We have lingered on 'the way, to admire coloured and double stars, choice flowers of the sky, and

Evenings with the Stars

we have marvelled at the wonders revealed by the telescope and photography in connexion with clouds of star mist and clusters of stars, and those mysterious dark vacant regions of the sky where no glimmer of light can be obtained.

We are now able to exchange friendly greetings with the leading actors in the celestial drama, as they reappear in due season. No less than ten of the brightest stars are in view when Sirius, the king of stars, rises above the south-eastern horizon, to share with Orion and Taurus the centre of the celestial stage. Capella overhead is twinkling a merry welcome, Perseus, Cassiopeia, and Andromeda are preparing to make their exit due west. Low down in the north-west Vega glitters while taking a final glimpse ere vanishing for the season. With eyes turned in the direction of the vanishing star, the Dragon due north is twisting its "tortuous way" between the Bears, who are making their ceaseless round in the north.

A glance eastward shows our friend Leo preparing to make its entrance, informing us that our circle around the year with the stars is complete, and the celestial pageant is about to recommence. Thus year in and year out we can watch the continuous performance which takes place among our stellar friends in the sky. Their programme is ever the same, and oh! the

Gemini, the Twins

pleasure to be derived from watching the display without having constantly to refer to star charts In the contemplation of the stars we thus find, as Milton wrote—

A perpetual feast of nectared sweets
Where no crude surfeit reigns

VOICES OF THE SUNS

R. A. PROCTOR, F.R.A.S.

I WATCHED the depths of darkness infinite
Bestrewn with stars, till dreaming I beheld
From out the mystic realms beyond my ken
A star come forth with even gliding rush ;
Till sweeping onward shone its orb
With all the mighty meaning of a sun,—
A sun girt round with many-peopled worlds,
And worlds as yet not peopled, being young,
And worlds long since unpeopled, being old
And dead Their ruling sun shone on them—
On the living, on the yet unfashioned,
On the dead , on all it shone, though idly
Where as yet life had not sprung forth, and
 idly, too,
Where life had ceased to be. On all those worlds
The mystic force which lived in matter worked
Its mighty will. Dead worlds, and worlds scarce
 born,
And worlds alive with myriad forms of life,
Swept circling round that stately ruling orb.

As it sailed past, I heard its solemn voice
Proclaiming through the realms of space the song,
The everlasting song of Life and Death—
Of wealth of Life and everduring waste
And dearth of Life. It sang of present, past,

Voices of the Suns

And coming plenitudes of Life , of past
And coming wastes of Death , infinitudes
At once of Life and Death , each without end,
Without beginning each

“ Along my path,
In front,” it said, “ and backwards whence I came,
And all around, above, below, my course,
Lie millions such as I, through endless realms
Of star-strewn space There is no end to God’s
Domain of suns, and systems ruled by suns—
No end and no beginning through all space—
But everlasting, mystic, wonderful.
The song of us sounds ever round the throne
Of Him who reigns supreme, the Life of All,
Unknown !, Yea, ever more Unknowable ! ”

Then, as the Psalmist sang of old, I said—
Because so moved, I could not choose but speak—
“ What, Lord, is man, that Thou shouldst care
For him, or for his kind ? The son of man, that
Thou

Shouldst mindful be of him or his ? ” Then rang
A voice of solemn thunder through the spheres .
“ Say, rather, what is space or time to Me,
That thou shouldst deem mere mightiness of mass
And plenitude of time can outweigh mind
And soul. Can worlds and suns My power know ?
Can æons sing My praise, as man,
Gifted by Me with power to know My power,
can tell

Evenings with the Stars

The meaning of the music of My spheres? ”
Then I said · “Nay, Lord, but if the words
Of men are worth the utterance, they are Thine.
Lo, we are but the creatures of Thy hand.
We see but part of all Thy wondrous work
Could we but see the glory of Thy light,
Could we but hear the thunder of Thy power,
We should become both blind and deaf—
Deafened by strident tones, made blind by light
In Thee alone we live and move, in Thee
We have our being But shall we, finite, hymn
The praises of Thine Infinite? Shall weak man,
The creature, paint with erring brush the Sun
Of Might and Power and Wisdom evermore
supreme? ”

* * * *

The answer came “Shalt thou, My creature,
doubt,
Or hold My Will in question? Learn that the
least
Of all the minds My Will has made
Outweighs not once but many thousand times
The mightiest mere mass, the thoughts of
human hearts
Outvie the movements of a million suns,
The rush of systems infinite through space ”

Published in my father's magazine *Knowledge*, October 12th, 1883
In a footnote to the poem are the words “Lines suggested by four
lectures on Astronomy” The lectures were, “Birth and Death of
Worlds,” “The Sun,” “The Moon” and “The Star Depths”

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